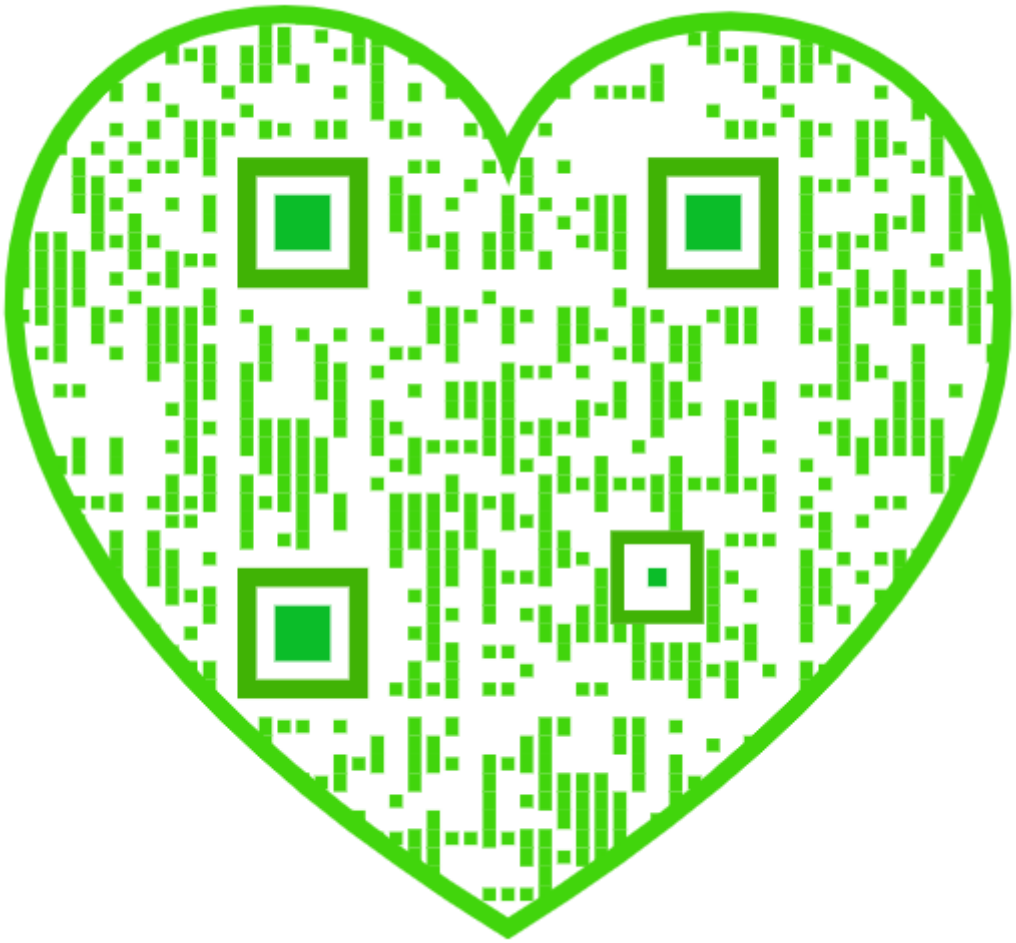

THE

PRACTICE OF PHARMACY:

A TREATISE

ON THE MODES OF MAKING AND DISPENSING OFFICINAL, UNOFFICINAL, AND EXTEMPORANEOUS PREPARATIONS, WITH DESCRIPTIONS OF THEIR PROPERTIES, USES, AND DOSES.

INTENDED AS A

HAND-BOOK FOR PHARMACISTS AND PHYSICIANS

AND A

TEXT-BOOK FOR STUDENTS.

BY

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WITH NEARLY FIVE HUNDRED ILLUSTRATIONS.

PHILADELPHIA:
J. B. LIPPINCOTT COMPANY.
LONDON: 15 RUSSELL STREET, COVENT GARDEN.
1886.

Entered according to Act of Congress, in the year 1885, by
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PREFACE.

THE rapid and substantial progress made in Pharmacy within the last decade has created a necessity for a work treating of the improved apparatus, the revised processes, and the recently introduced preparations of the age.

The vast advances made in theoretical and applied chemistry and physics have had much to do with the development of pharmaceutical science, and these have been reflected in all the revised editions of the Pharmacopœias which have been recently published. When the author was elected in 1874 to the chair of Theory and Practice of Pharmacy in the Philadelphia College of Pharmacy, the outlines of study which had been so carefully prepared for the classes by his eminent predecessors, Professor William Procter, Jr., and Professor Edward Parrish, were found to be not strictly in accord, either in their arrangement of the subjects or in their method of treatment. Desiring to preserve the distinctive characteristics of each, an effort was at once made to frame a system which should embody their valuable features, embrace new subjects, and still retain that harmony of plan and proper sequence which are absolutely essential to the success of any system.

The strictly alphabetical classification of subjects which is now universally adopted by Pharmacopœias and Dispensatories, although admirable in works of reference, presents an effectual stumbling-block to the acquisition of pharmaceutical knowledge through systematic study: the vast accumulation of facts collected under each head being arranged lexically, they necessarily have no connection with one another, and thus the saving of labor effected by considering similar groups together, and the value of the association of kindred subjects, are lost to the student. In the method of grouping the subjects which is herein adopted, the constant aim has been to arrange the latter in such a manner that the reader shall be gradually led from the consideration of elementary subjects to those which involve more advanced knowledge, whilst the groups themselves are so placed as to follow one another in a natural sequence.

The work is divided into six parts. Part I. is devoted to detailed descriptions of apparatus and definitions and comments on general pharmaceutical processes.

The Officinal Preparations alone are considered in Part II. Due weight and prominence are thus given to the Pharmacopœia, the National authority, which is now so thoroughly recognized.

In order to suit the convenience of pharmacists who prefer to *weigh solids* and *measure liquids*, the officinal formulas are expressed, in addition to parts by weight, in *avoirdupois weight* and *apothecaries' measure*. These equivalents are printed in *bold type*, near the margin, and arranged so as to fit them for quick and accurate reference.

Part III. treats of Inorganic Chemical Substances. Precedence is of course given to officinal preparations in these. The descriptions, solubilities, and tests for identity and impurities of each substance are systematically tabulated under its proper title. It is confidently believed that by this method of arrangement the valuable descriptive features of the Pharmacopœia will be more prominently developed, ready reference facilitated, and close study of the details rendered easy. Each chemical operation is accompanied by equations, whilst the reaction is, in addition, explained in words.

The Carbon Compounds, or Organic Chemical Substances, are considered in Part IV. These are naturally grouped according to the physical and medical properties of their principal constituents, beginning with simple bodies like cellulin, gum, etc., and progressing to the most highly organized alkaloids, etc.

Part V. is devoted to Extemporaneous Pharmacy. Care has been taken to treat of the practice which would be best adapted for the needs of the many pharmacists who conduct operations upon a moderate scale, rather than for those of the few who manage very large establishments. In this, as well as in other parts of the work, operations are illustrated which are conducted by manufacturing pharmacists.

Part VI. contains a Formulary of Pharmaceutical Preparations which have not been recognized by the Pharmacopœia. The recipes selected are chiefly those which have been heretofore rather difficult of access to most pharmacists, yet such as are likely to be in request. Many private formulas are embraced in the collection; and such of the preparations of the old Pharmacopœias as have not been included in the new edition, but are still in use, have been inserted.

In conclusion, the author ventures to express the hope that the work will prove an efficient help to the pharmaceutical student as well as to the pharmacist and the physician. Although the labor has been mainly performed amidst the harassing cares of active professional duties, and perfection is known to be unattainable, no pains has been spared to discover and correct errors and omissions in the text. The author's warmest acknowledgments are tendered to Mr. A. B. Taylor, Mr. Joseph McCreery, and Mr. George M. Smith for their valuable assistance in revising the proof-sheets, and to the latter especially for his work on the index. The outline illustrations, by Mr. John Collins, were drawn either from the actual objects or from photographs taken by the author.

PHILADELPHIA, October, 1885.

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PRACTICE OF PHARMACY.

INTRODUCTORY.

PHARMACOPŒIAS AND DISPENSATORIES.

A *pharmacopœia*, in the modern acceptation of the word, is a book containing a selection of medicinal substances, with formulas for their preparation. The necessity for legalized standards to define the character, establish the purity, and regulate the strength of medicines is recognized by all civilized nations. At the present time the most important pharmacopœias, with the dates of their last issue, are as follows:

OFFICIAL PHARMACOPŒIAS.

Nation.	*Date of Issue.*	*Title.*
United States	1882	Pharmacopœia of the United States of America.
Great Britain and Ireland	1885	British Pharmacopœia.
Germany	1882	Pharmacopœa Germanica.
France	1884	Codex Medicamentarius (Pharmacopée Française).
Austria	1869	Pharmacopœa Austriaca.
Russia*	1880	Pharmacopœa Rossica.
Sweden	1869	Pharmacopœa Suecica.
Norway	1879	Pharmacopœa Norvegica.
Denmark	1868[1]	Pharmacopœa Danica.
Belgium	1881	Pharmacopœa Belgica.
Switzerland	1872[2]	Pharmacopœa Helvetica.
Spain	1865	Farmacopea Española.
Portugal	1876	Pharmacopêa Portugueza.
East Indies	1868[3]	Pharmacopœia of India.
Hungary	1871	Pharmacopœa Hungarica.
Netherlands	1871	Pharmacopœa Neerlandica.
Roumania	1862	Pharmacopœa Româna.
Finland	1863	Pharmacopœa Fennica.
Italy†		
Chili†		
Greece*	1868	ΈΛΛΗΝΙΚΗ ΦΑΡΜΑΚΟΠΟΙΙΑ.
Japan†		
Mexico	1884	Nueva Farmacopea Mexicana.

Those marked with an * indicate that new editions are in preparation. Those marked with a † show that the first editions of Pharmacopœias are being prepared.

[1] Additions, 1874, 1876. [2] Supplement, 1876. [3] Supplement, 1869.

The following list of countries which have no national pharmacopœia shows the standard pharmaceutical work or works in general use:[1]

ARGENTINE REPUBLIC.—Codex Medicamentarius (Pharmacopée Française).
Tratado de Farmacia y Farmacognosia. By Charles Murray. (Not official.) (A national pharmacopœia is "in process of compilation, under direction of the pharmaceutical societies, authorized by the government.")
BRAZIL.—Codex Medicamentarius.
Formulario ou Guia Medica. By Chernoviz. Tenth edition. Paris. 1879. (Not official.)
Novo Formulario medico e pharmaceutico, ou Vademecum Medicum, por Th. J. H. Langgaard. Rio de Janeiro. 1872.
CENTRAL AMERICAN STATES.—La Officina de Farmacia; a translation into the Spanish language and rearrangement of Dorvault's L'Officine. Pontes. Second edition. Madrid. 1879. (Not official.)
CHINA.—Pun-tsao-kang-muh (the Chinese Herbal). By Le-shé-chin. 1596. In 40 thin 8vo volumes. (The foreign druggists use the pharmacopœias of their respective countries, or as required by physicians, —principally the British Pharmacopœia.)
CUBA.—Farmacopea Española.
Formulario de los hospitales. 1858. (Not official.)
DENMARK.—Pharmacopœa Nosocomii Civitatis Hauniensis. Copenhagen. 1881. (Not official.)
Supplementum Pharmacopœæ Danicæ. T. S. Warncke. Hauniæ. 1869. (Not official.)
HAYTI.—Codex Medicamentarius.
HAWAIIAN ISLANDS.—The United States Pharmacopœia, and occasionally the British Pharmacopœia.
ITALY.—Farmacopœa per gli Stati Sardi. Turin. 1853.
Farmacologia, teorica e practica, ovvero Farmacologia Italiana. Giuseppe Orosi. Milan. 1866–67. Fourth edition. (Not official.)
Farmacopea nazionale e generale; Materia Medica e Terapia. Prof. Dr. C. Ruata. Verona e Padua. 1883.
Ricettario Farmaceutico Napolitano. Naples. 1859. (Not official.)
Pharmacopœa Austriaca, in Lombardy and Venetia.
Pharmacopœa (title unknown), in Parma, Modena, and Piacenza.
Codice Farmaceutico Romano. Compilato e pubblicato per ordine di Sua Santità Papa Pio IX. 1868.
LIBERIA.—The United States and British Pharmacopœias.
PARAGUAY.—Codex Medicamentarius.
TURKEY.—Codex Medicamentarius. (Officially prescribed.)
URUGUAY.—Codex Medicamentarius. Occasionally the United States Pharmacopœia, Pharmacopœa Germanica, British Pharmacopœia, and L'Officine.
VENEZUELA.—Codex Medicamentarius. Also in use Pontes's La Officina, the Farmacopea Española, and rarely the United States or British Pharmacopœias.

The official Pharmacopœias are all issued under the authority of the respective governments, with the exception of the United States Pharmacopœia (which has, however, been accepted by the government as a standard in some of the departments), the policy of the nation having been against interference in matters which relate to restrictions upon professional practice. This course has not prevented the acceptance of the work by physicians and pharmacists as an authoritative guide, whilst it has probably encouraged a greater freedom in criticism, and thus developed more general interest in a standard and a stronger desire for improvement than could have been obtained through compulsory legislation. At the present time an effort is being made to secure the adoption of an International Pharmacopœia. If this proves successful, a great advance will be made in bringing about a uniformity in the strength of preparations; yet it may well be doubted whether such a work would be as generally useful as the Pharmacopœias at present in use, which have been proved by long experience best adapted to the varying needs of the different nations.

The Pharmacopœia of the United States (1882), Sixth Decennial Revision, was prepared by a committee appointed by the National Convention for revising the Pharmacopœia, which met in Washington, D. C., May 5, 1880; thirty-five medical bodies and eleven incorporated pharmaceutical colleges sent delegates to this convention, which selected from those present twenty-five members, consisting of fourteen pharmacists and eleven physicians, who were designated the Committee of Revision and Publication of the Pharmacopœia of the United States of America. As this book will be largely quoted in this treatise, its plan and the

[1] Dr. J. M. Flint, Surgeon U.S.N.

outlines of its main features should be thoroughly understood at the outset.

Nearly one thousand substances (997), embracing crude drugs and preparations, have been deemed of sufficient importance to merit a place in the United States Pharmacopœia. These substances were formerly divided into two classes, "Materia Medica" and "Preparations;" the former class contained a list of medicines which were either crude drugs, or were furnished by manufacturers, and not usually prepared by the pharmacist; the latter class was composed of formulas or processes indicating how preparations were to be made. At the Sixth Decennial Revision this arbitrary method of division was dropped, and a strictly alphabetical arrangement of all the substances adopted: this facilitates a ready reference, and disarms criticism upon a method of classification.

NOMENCLATURE.

The titles of the various substances are indicated, 1st. By the OFFICINAL NAME, which is always in the Latin language. 2d. By the ENGLISH NAME. 3d. By the SYNONYME. 4th. By the BOTANICAL NAME (in the case of plants). 5th. By SYMBOLIC FORMULÆ (in the case of chemicals). Each of these names has a special use.

The following extracts from the Pharmacopœia are given in illustration:

CANNABIS INDICA.	[Officinal name.]	**ELIXIR AURANTII.**
INDIAN CANNABIS.	[English name.]	ELIXIR OF ORANGE.
[INDIAN HEMP.]	[Synonyme.]	[SIMPLE ELIXIR.]
ZINCI IODIDUM.	[Officinal name.]	**PRUNUS VIRGINIANA.**
IODIDE OF ZINC.	[English name.]	WILD CHERRY.
ZnI_2; 318.1.—*ZnI*; 159.05. [Symbolic formulæ.]		The bark of *Prunus serotina*. [Botanical name.]

1. The Officinal Name.—Example, **CERATUM CANTHARIDIS.** The officinal name is thoroughly distinctive, and is intended to be used in designating the drug or preparation where precision is required, as in writing prescriptions, in labelling store-furniture, specimens, etc. Latin is selected for the officinal title because it is universally used and understood as the "language of science," and is not liable to change, as is the case with a living tongue. Although the officinal names are usually abbreviated in practice,[1] the proper terminations and full titles should be known and observed carefully, and the habit of using the Latin abbreviations in English conversation strictly guarded against as not only inelegant, but vulgar.[2] A vast amount of careful consideration, extending over many years, has been expended in perfecting a system of pharmacopœial nomenclature which is at once "brief, simple, expressive, distinctive, and convenient." The following may be cited as models: Allium, Camphora, Opium, Rheum, Sapo, etc., the full pharmacopœial definition of these titles being, respectively, *Allium.*

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[1] See table of abbreviations in chapter on Prescriptions.

[2] Example of what should be avoided in conversation: "I mixed the *Pulv. Pip. Nig.* with the *Pot. Carb.* and the *Muc. Trag.*, but could not form a mass."

"The bulb of *Allium sativum* Linné (Nat. Ord., *Liliaceæ*)."[1] *Camphora.* "A stearopten derived from *Cinnamomum Camphora* F. Nees et Ebermaier (Nat. Ord., *Lauraceæ*), and purified by sublimation."[1] *Opium.* "The concrete, milky exudation, obtained in Asia Minor by incising the unripe capsules of *Papaver somniferum* Linné (Nat. Ord., *Papaveraceæ*)."[1] *Rheum.* "The root of *Rheum officinale* Baillon and of other undetermined species of *Rheum* (Nat. Ord., *Polygonaceæ*)."[1] *Sapo.* "Soap prepared from soda and olive oil." The officinal definition in each case indicates as plainly as possible the source and the particular form of the drug or substance which is to be selected. The *generic* or genus name (the first part of the botanical name) was generally chosen for the officinal title, as, Pilocarpus, the officinal name for "the leaflets of *Pilocarpus pennatifolius*" (botanical name). In the case of some old and very well known drugs, this rule could not be adopted without causing confusion, and the *specific* or species name (the second part of the botanical name) was retained, as Ipecacuanha, the officinal name for "the root of *Cephaëlis Ipecacuanha.*" The officinal title obviously cannot retain the simplicity of a single word where two parts of the same plant are officinal; thus, for example, the root and seed of Colchicum must each be defined by affixing the Latin name of the particular part of the plant intended, as, *Colchici Radix* for Colchicum Root and *Colchici Semen* for Colchicum Seed; nor can a single word be chosen for either officinal title where the specific names of two or more plants of the same genus differ; the generic name of the two officinal mints is Mentha, and to distinguish them it is necessary to use the full botanical name for each,—thus, *Mentha Piperita* (Peppermint), *Mentha Viridis* (Spearmint).

There are a very few exceptions to the above principles of nomenclature, as in the case of *Pareira* and *Prunus Virginiana*, derived, according to the most recent and reliable authorities, respectively from *Chondodendron tomentosum* and *Prunus serotina;* these drugs are largely used, and the old names have become so well established that it would lead to confusion and possibly embarrassing mistakes to change them now. The Latin names are generally used in the singular number, although the definition of the drug distinctly indicates plurality; for instance, *Galla* is the officinal name for *nutgalls*, as they are termed commercially, and is in the nominative singular (plural, *Gallæ*); the officinal definition indicates the plural, being "Excrescences on Quercus lusitanica." *Anthemis* (nominative singular), the officinal name for the flower-heads of Chamomile. The reason assigned in the preface to the U. S. Pharmacopœia, 1850, for this apparent deviation, is that "the example of the Roman medical writers, particularly of Celsus, might be followed." In the case of compound medicines, such officinal titles were selected as would usually express the composition of the preparations as fully as possible, indicating the principal ingredients without sacrificing the important consideration of brevity and convenience in abbreviation, as, Mistura Rhei et Sodæ, Mistura Cretæ, Pulvis Ipecacuanhæ et Opii, Tinctura Opii Camphorata, Tinctura Aloes et Myrrhæ.

[1] The words enclosed in quotation-marks are appropriately termed *the officinal definition.*

Where the number of important ingredients in a preparation is too great to admit of a selection, the participial adjective *compositus* (meaning compound) is added, the feminine (*composita*) or neuter (*compositum*) termination being used respectively where the noun is feminine or neuter, as Spiritus Juniperi Compositus (masc.), Tinctura Lavandulæ Composita (fem.), Extractum Colocynthidis Compositum (neut.).

2. The English Name.—Example, **SOLUTION OF ACETATE OF AMMONIUM.** The English name should be used when the drug or preparation is mentioned in ordinary conversation, in commercial transactions, in writing orders for supplies, and in all cases where the use of the Latin officinal name could be justly criticised as an ostentatious display of erudition. In the U. S. Pharmacopœia, 1880, a large number of English names used in former Pharmacopœias were changed, the old vernacular names being either dropped altogether or inserted as synonymes: this advanced step was rendered necessary by the increase in articles used in the Materia Medica and by a desire for greater accuracy and better methods in nomenclature. The confusion which always exists in different localities concerning the common names of drugs is also avoided, as the anglicized Latin name is distinctive. The former English names *Dogwood, Irish Moss, Pipsissewa, Butternut,* and *Wormseed,* for instance, are replaced by *Cornus, Chondrus, Chimaphila, Juglans,* and *Chenopodium.*

On the other hand, some of the common English names were so fixed by usage that it was not deemed judicious to alter them; besides, to have changed them would have often substituted a longer and less convenient word. The retention of the English names of *Cloves, Orris Root, Elm Bark, Hops,* and *Ginger* sufficiently illustrates this.

3. The Synonyme.—Example, [SPIRIT OF MINDERERUS.] In the Pharmacopœia the definition of the term synonyme is restricted to an equivalent name in common use, which is usually antiquated and derived from an unscientific source, and which should really be abandoned, but which common custom and long usage demand shall not be entirely ignored. The synonymes should be rarely or never used, yet it is necessary for the student to be familiar with them in order to recognize their equivalent officinal or English names when they are used by others. Common names, as snake root, dock, Indian hemp, balm, etc., have varying and often opposite meanings in different localities, and confusion and even loss of life have resulted from the unfortunate use of these common names.

4. The Botanical Name.—By this is meant the systematic name recognized by botanists for plants, which serves in pharmacopœial nomenclature as the basis of the officinal name. The botanical name usually consists of two Latin words, the first indicating the genus, and the second the species to which the plant belongs. *Capsicum fastigiatum* is the botanical name for the particular variety of capsicum or Cayenne pepper which the Pharmacopœia designates; here the generic or first name is chosen for the officinal title, and if no description followed the title, it would be inferred that any part of any plant in the genus "Capsicum" could be officinally used for making preparations; but the specific name, "fastigiatum," limits the use to this species, whilst the description

which follows shows the *part* of the plant which must be employed, "the *fruit* of Capsicum fastigiatum." Now, Capsicum baccatum, Capsicum frutescens, Capsicum annuum, belonging to different species, are active members of the genus, but their claims are unrecognized, and the fruit from these species is not officinal. The specific names do not usually begin with a capital letter, except when the specific name has been derived from a generic name, as in Rhamnus Frangula, or when the specific name has been derived from that of a person, as in Strychnos Ignatii, or when the word is indeclinable, as Erythroxylon Coca. The name of the author follows the botanical name, as *Capsicum fastigiatum* Blume, and after this, the Natural Order[1] to which the plant belongs is indicated in italics, and the whole enclosed in parentheses, as, (Nat. Ord., *Solanaceæ*). It must be apparent that the botanical name need not be employed either in writing or speaking in ordinary pharmaceutical work; but its use is absolutely necessary in establishing the identity of any drug authorized by the Pharmacopœia, and hence it is important to know the botanical names.

5. The Symbolic Formulæ.—The adoption of certain arbitrary symbols[2] to represent chemical elements leads to a most convenient and useful application, whereby the composition of a chemical is expressed with the utmost brevity and exactness. Sodii Iodidum and Iodide of Sodium are both much longer terms than "NaI," and not so definite. Neither the officinal nor the English name in all cases expresses accurately the composition of a chemical. $(ZnCO_3)_2.3Zn(HO)_2$ is the officinal symbolic formula for precipitated carbonate of zinc, and the composition is here plainly shown to be two molecules of carbonate of zinc and *three* molecules of *hydrate of zinc;* Zinci Carbonas Præcipitatus is long enough for an officinal title, and it is not deemed wise to cumber it with the added name of the secondary product associated with it. *Sulphite of Sodium* does not always contain the same proportion of water of crystallization, and if the symbolic formula, $Na_2SO_3.7H_2O$, were not appended to the officinal title there might be some doubt about which sulphite was intended: the added $7H_2O$, however, accurately defines it. The symbolic formulæ are expressed in the Pharmacopœia in both the new and old systems of chemical nomenclature, for the convenience of some who are yet unaccustomed to the change. The former, however, *should alone* be employed, as it is now in general use, and it is given the first place in the Pharmacopœia, the old system being expressed in italics. The *figures* which follow the symbolic formulæ indicate the *molecular weight* (the sum of the weight of the atoms) of the chemical: thus, in $Na_2So_3.7H_2O=252$, the atomic weight of Sodium Na, 23, multiplied by 2, gives 46, this added to Sulphur S, 32, makes 78; Oxygen O, 16, multiplied by 3, gives 48; this added to 78 makes 126. Now, the atomic weight of Hydrogen H being 1, seven times 1 multiplied by 2 make 14, this added to 126 gives 140, and seven times O, 16, being 112, added to this, make 252, the molecular weight of sulphite of sodium.

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[1] See index for chart of drugs arranged according to the Natural Orders.
[2] See index for table of elements, with symbols and atomic and molecular weights.

The Officinal Description.—Immediately following the officinal definition of the substances there will be noticed in the Pharmacopœia, in smaller type, what has been termed the *officinal description:* this consists, usually, in drugs, of a concise statement of their physical characteristics, whilst in some cases tests of identity, with descriptions of the substances used as adulterants, are appended. In the chemicals the officinal definition is usually replaced by the symbolic formulæ, and these are followed immediately by the officinal description, which is printed in smaller type, exactly as in the case of the drugs; to this description are usually added the solubilities, with the tests of identity and purity of the substance. The following examples, selected from the Pharmacopœia, are given in illustration:

MYRRHA	[Officinal name.]	**AMMONII NITRAS.**
MYRRH.	[English name.]	NITRATE OF AMMONIUM.
A gum-resin obtained from *Balsamodendron Myrrha* Nees (Nat. Ord., *Burseraceæ*).	[Officinal definition.]	[Symbolic formulæ.] NH_4NO_3; 80.—NH_4O,NO_5; 80.
In roundish or irregular tears or masses, dusty, brownish-yellow or reddish-brown; fracture waxy; . . . taste bitter and acrid. When triturated with water, Myrrh yields a brownish-yellow emulsion; with alcohol it yields a brownish-yellow tincture which acquires a purple hue on the addition of nitric acid.	[Officinal description.]	Colorless crystals, generally in the form of long, thin, rhombic prisms, or in fused masses. . . . Soluble in 0.5 part of water and in 20 parts of alcohol; very soluble in boiling water and in 3 parts of boiling alcohol. . . . The aqueous solution, when acidulated with nitric acid, should not be rendered cloudy by test-solution of nitrate of silver. . .

THE PREPARATIONS OF THE PHARMACOPŒIA.

Although these will be considered in detail in the body of this work, a few general remarks on them will be appropriate here. The adoption of the principle of "parts by weight" at the revision of 1880, and also that of the centesimal ratio, render the calculation of the numerical weight relation of the ingredients very simple, it being a question of percentage: the following example shows the method of arrangement:

PILULÆ RHEI COMPOSITÆ.

COMPOUND PILLS OF RHUBARB.

	Grains.
Rhubarb, in No. 60 powder, *two hundred grains*	200
Purified Aloes, in fine powder, *one hundred and fifty grains*	150
Myrrh, in fine powder, *one hundred grains*	100
Oil of Peppermint, *ten grains*	10
	460
To make *one hundred pills*	100

By simply pointing off decimally we find that each pill contains 2 grains of Rhubarb, $1\frac{1}{2}$ grains of Aloes, 1 grain of Myrrh, and $\frac{1}{10}$ of a grain of Oil of Peppermint.

In the construction of many of the formulæ it was impossible to retain the centesimal ratio, owing to the relatively small proportion of one or more of the ingredients; in such cases a multiple of 100 was usually chosen. Thus, in Camphorated Tincture of Opium the end product is 1000, because the percentage of powdered opium, benzoic acid, camphor,

and oil of anise would have to be expressed by a fraction, and $\frac{4}{10}$ of a grain of each would be an inconvenient quantity. In every case where there has been a deviation from the rule there have been good special reasons.

As it will be found most convenient for practical pharmacists to measure liquids in preference to weighing them, the corresponding measures are given as alternatives in the working formulas found in the succeeding chapters of this work.

DISPENSATORIES.

A dispensatory is a commentary on a pharmacopœia. The U. S. Pharmacopœia describes the drugs and chemical substances of the materia medica, establishes the degree of purity of many of them, and defines the strength of the preparations. The dispensatories comment on the substances, giving their physical, medical, and pharmaceutical history, with their doses and uses. The number of substances noticed in the pharmacopœia is *limited* to such as are in common and frequent use in some section of the country. On the other hand, the dispensatories aim to present information about those which are officinal in our own and other pharmacopœias, and those which are of occasional or rare use, in addition. There are at present two dispensatories which comment on the materia medica and preparations of the U. S. Pharmacopœia of 1880,—the United States Dispensatory,[1] which was first published in 1833, and the National Dispensatory, which was first issued in 1879.[2] The plans of these works are similar: the text of the Pharmacopœia is first inserted, and immediately following are appended the comments of the authors and editors. The arrangement of the subjects is now strictly alphabetical, the United States Dispensatory dividing them, however, into two classes, distinguished by type of two sizes: the principal portion of the work, that in the largest type, is devoted to a commentary on the preparations of the United States and British Pharmacopœias; the unofficinal and less important subjects are to be found in the second part. In the National Dispensatory the unofficinal substances are considered either in the body of the book or under subdivisions as allied drugs. The possession of a reliable commentary upon the Pharmacopœia is a *necessity* which is fully realized by pharmacists, and in the consideration of the subjects in the succeeding chapters of this work this fact has not been lost sight of. For these reasons it is not deemed necessary to enlarge further upon the merits of the dispensatories.

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[1] *United States Dispensatory*, edited by Wood, Remington, and Sadtler, published by J. B. Lippincott Company, Philadelphia.

[2] *National Dispensatory*, Stillé and Maisch, published by Lea Brothers & Co., Philadelphia. The *American Dispensatory*, King and Lloyd, published in Cincinnati, has not been issued since the publication of the U. S. Pharmacopœia, 1880. The *Companion to the United States Pharmacopœia*, Oldberg and Wall, published by William Wood & Co., New York, comments on the U. S. Pharmacopœia of 1880, but differs from the dispensatories in the fact that the processes of the Pharmacopœia are not published in full in the work, but are usually referred to, and the page in the Pharmacopœia upon which they are found is noted.

PART I.

CHAPTER I.

METROLOGY.

Weight, Measure, and Specific Gravity.

THE present definition of the science of metrology includes the measure of the gravitating force of bodies, which always bears a direct ratio to their mass, and is commonly called *weight;* the determination of the bulk or extent of the body, its *measure;* and the relation which measure bears to weight when compared with a standard, which is known as *specific gravity.*

WEIGHT.

A knowledge of the systems of weights and measures in use must necessarily command the early attention of the student, and a short account of the origin of the present systems may be of service in fixing upon the mind the essential distinctions between them. The sense of the weight of a body cannot be conveyed intelligibly to the mind unless a means of comparison is chosen, and as weight is the measure of the gravitating force of a body, so this force is expressed as related to a standard of resistance, this being exactly that which would balance the body and keep it in equilibrium.

The standards which have been chosen by various nations are arbitrary, and instances are common where different standards are in use at the same time in the same country. Many of the ancient standards are clearly referable to parts of the human body, as nail, foot, span, pace, cubit (length of the forearm), orgyia (stretch of the arms). In the history of metrology three periods may be traced: 1. The *Ancient*, during which the old classical standards originated, and which terminated with the decline of the Roman Empire. 2. The *Mediæval*, extending to the sixteenth century. In this period the old standards were lost, but their names were preserved, and European nations adopted various independent standards. 3. The *Modern*. Since the seventeenth century the efforts of most enlightened nations have been directed towards greater

accuracy and simplicity, and during the present century towards international uniformity.

In Great Britain, in the year 1266, the 51st act of the reign of Henry III. declares "that by the consent of the whole realm of England the measure of the King was made,—that is to say, that an English silver penny called the sterling, round and without clipping, shall weigh *thirty-two grains of wheat*, well dried and gathered out of the middle of the ear; and twenty pence (pennyweights) do make an ounce, and twelve ounces a pound, and eight pounds do make a gallon of wine, and eight wine gallons do make a bushel, which is the eighth of a quarter."

The sixteen-ounce pound (avoirdupois) was derived from a more ancient source, and was undoubtedly of Roman origin, and introduced at the time of the first civilization of the British island. The word "haberdepois," according to Gray, was, however, first used in English laws in 1303.

A statute of Edward I. (A.D. 1304) states "that every *pound* of money or of *medicines* is of *twenty shillings weight*, but the pound of all other things is *twenty-five shillings weight*. The *ounce* of *medicines* consists of *twenty pence*, and the *pound* contains *twelve* ounces (the Tower Pound), but in other things the pound contains *fifteen* ounces, in both cases the ounce weighing twenty pence."

These laws unfold the theory of the ancient weights and measures of Great Britain, and reveal the standard,—*i.e.*, a natural object, grains of wheat; a difference existed then between the troy and the avoirdupois pound, but the weights now in use are one-sixteenth heavier than those of Edward I., owing to the change made in the value of the coin by the sovereign subsequently; in addition to this, the true pennyweight standard was lost, and on the next revision of the weights and measures the present troy and avoirdupois standards were adopted. The old Tower or troy ounce and the avoirdupois ounce were intended to have the same weight, but after the revision it was found that the troy ounce was heavier than the avoirdupois ounce by forty-two and a half grains.

The subsequent adoption of troy weight by the London College of Physicians in 1618, on the recommendation of Sir Theodore Turquet de la Mayerne, who compiled their first Pharmacopœia, has entailed upon all apothecaries who are governed by British customs, to this day, the very great inconvenience of buying and selling medicines by one system of weights and compounding them by another.

In the next century efforts were made towards reforming the standards, and the Royal Society, in 1736, began the work, which ended in the preparation, under the direction of the House of Commons, by Mr. Bird, of the standard "yard" and standard "pound" troy in 1760. Copies of these have been made, no intentional deviation has been made since, and they are still the standards used most largely in the United States. In 1816, on account of the growing popularity of the French metrical system, and in view of the desirability of securing a standard which could easily be recovered in case of loss or destruction and which should be commensurable with a simple unit, steps were taken in England to secure these advantages. The labors of English scientists

led to the adoption of the *Imperial* measures and standards, which were legalized January 1, 1826, and are now in general use in Great Britain.

In this system the *yard* is equivalent to 36 inches, and its length was determined by comparison with a pendulum beating seconds of mean time, in a vacuum, at the temperature of 62° F. at the level of the sea, in the latitude of London, which length was found to be 39.1393 inches. The *pound troy* (containing 5760 grains) was determined by comparison with a given measure of distilled water under certain conditions: thus, a cubic inch of distilled water was weighed with brass weights in air at 62° F., the barometer at 30 inches, and it weighed 252.458 grains. The standard for measures of capacity (either dry or liquid) is the *gallon*, and this contains 10 pounds avoirdupois (each 7000 grains) of distilled water weighed in air at 62° F., the barometer standing at 30 inches; the *bushel* containing 8 such gallons. In 1819–20 efforts were made in the United States to secure uniformity in the standards which were in use by the several States, these being copies of the Bird standards (1760), and not at all accurate. Finally, after a lengthy investigation, the Secretary of the Treasury, on June 14, 1836, was directed by Congress to furnish each State in the Union with a complete set of the revised standards, and thus we have the *troy pound* (5760 grains), the *avoirdupois pound* (7000 grains), and the *yard* (36 inches) all identical with the British standards; but the *gallon* is quite different, the old wine gallon of 231 cubic inches, containing 58372.2 grains of distilled water at its maximum density, weighed in air of the temperature of 62° F., the barometer standing at 30 inches, *being retained*, whilst the bushel contains 77.6274 pounds of water under the same conditions. In 1864 the use of the metric measures was legalized in Great Britain, but not made compulsory, and in 1866 the United States followed the same course.

Troy or Apothecaries' Weight.

Pound.		Troy Ounces.		Drachms.		Scruples.		Grains.
℔ 1	=	12	=	96	=	288	=	5760
		℥ 1	=	8	=	24	=	480
				ʒ 1	=	8	=	60
						℈ 1	=	gr. 20

The British Pharmacopœia does not recognize troy weight in its formulas, but authorizes avoirdupois weight, which is also in general use in the United States for commercial purposes.

Avoirdupois Weight.

Pound.		Ounces.		Grains.
℔ 1	=	16	=	7000
		oz. 1	=	437.5

It will be observed that the troy ounce contains 42½ grains *more* than the avoirdupois ounce, whilst the troy pound contains 1240 grains *less* than the avoirdupois pound. Fortunately, one unit common to troy, apothecaries', and avoirdupois weight has been saved,—namely, *the grain*. The abbreviations of the denominations of apothecaries' weight are represented by the signs ℥, ounce, ʒ, drachm, ℈, scruple, and gr., grain; these have long been in use, but are very likely to be mistaken for one

another in rapid or careless writing. The abbreviations or signs for avoirdupois weight differ from those of troy weight, and care should be used not to confound them; they are ℔., pound, oz., ounce, gr., grain.

MEASURES.

Apothecaries' or Wine Measure, U.S.

Gallon.		Pints.		Fluidounces.		Fluidrachms.		Minims.
Cong. 1	=	8	=	128	=	1024	=	61440
		O 1	=	16	=	128	=	7680
				f℥ 1	=	8	=	480
						f℥ 1	=	♏ 60

Imperial Measure, Br.

(Adopted by the British Pharmacopœia.)

Gallon.		Pints.		Fluidounces.		Fluidrachms.		Minims.
C. 1	=	8	=	160	=	1280	=	76800
		O 1	=	20	=	160	=	9600
				fl. oz. 1	=	8		480
						fl. dr. 1	=	min. 60

When the subject of the weights and measures in ordinary use is studied, the want of simplicity and close relation is clearly apparent. The pint of distilled water at 15.6° C. (60° F.) weighs 7291.2 grains, the fluidounce 455.7 grains, and we have thus three ounces in use of different values,—troy ounce 480 grains, avoirdupois ounce 437.5 grains, and fluidounce 455.7 grains.

The Imperial measure differs from our wine measure principally in having twenty fluidounces in the pint instead of sixteen: this difference, however, furnishes a convenient relation between measure and weight in the *Imperial gallon, which contains ten pounds of water* at 15.6° C. (60° F.).

The Imperial fluidounce contains the same number of grains as the avoirdupois ounce (437.5), which is 18.2 grains less than that of the U. S. fluidounce of water at the same temperature (455.7). Although this difference may be considered trifling in one fluidounce, it is not so when multiplied by four or eight, and this is one serious objection to the use of the English graduated measures in the United States, because they indicate Imperial fluidounces instead of U. S. fluidounces.

Approximate Measures.

In apportioning doses for a patient, the practitioner is usually compelled to order the liquid medicine to be administered in certain quantities that have been established by custom, and estimated as follows:

A teacupful . . . . . f℥iv.
A wineglassful . . . . . f℥ij.
A tablespoonful . . . . . f℥iv.
A dessertspoonful . . . . . f℥ij.
A teaspoonful . . . . . f℥i.
A drop, through a popular error, is considered to be 1 minim.[1]

In almost all cases the modern teacups, tablespoons, dessertspoons, and teaspoons, after careful tests by the author, were found to average twenty-five per cent. greater capacity than the theoretical quantities given above; and the use of accurately graduated medicine-glasses, which may be had now at a trifling cost, should be insisted upon.

[1] See comparative table, p. 62.

The Metric System.—This system, which originated with Prince de Talleyrand, Bishop of Autun, France, in 1790, seems destined to become universal, as it is now legally used by the majority of all civilized nations, and finds especial favor with scientists even in countries where its use is not compulsory. The starting-point was the *unit of length*, the **metre**, which is the $\frac{1}{40,000,000}$ part of the earth's circumference around the poles. From this, the *unit of capacity* was derived, the **litre**, which is the cube of $\frac{1}{10}$ part of a metre. The *unit of weight*, the **gramme**, was also derived from the metre, it being the weight of that quantity of distilled water, at its maximum density, 4° C. (39.2° F.), which will fill the cube of $\frac{1}{100}$ part of a metre.[1] The name Metrical System, it will thus be seen, is very appropriate, as *each unit is derived from the metre;* it is also known as the *Decimal System*, because in obtaining the multiples and subdivisions the number ten (*decem*) is used solely. The prefixes, which indicate *multiplication*, are of Greek derivation, and are usually spelled with a capital letter,—**Deka**, 10, **Hecto**, 100, **Kilo**, 1000, **Myria**, 10,000; whilst *division* of the units is expressed by Latin prefixes, the initial letters not being capitals,—**deci**, $\frac{1}{10}$, **centi**, $\frac{1}{100}$, **milli**, $\frac{1}{1000}$. The word Gild has been suggested as a useful mnemonic, thus,—

G I L D
reek ncreases, atin ecreases.

The following table gives a view of the system adapted to the use of the student:

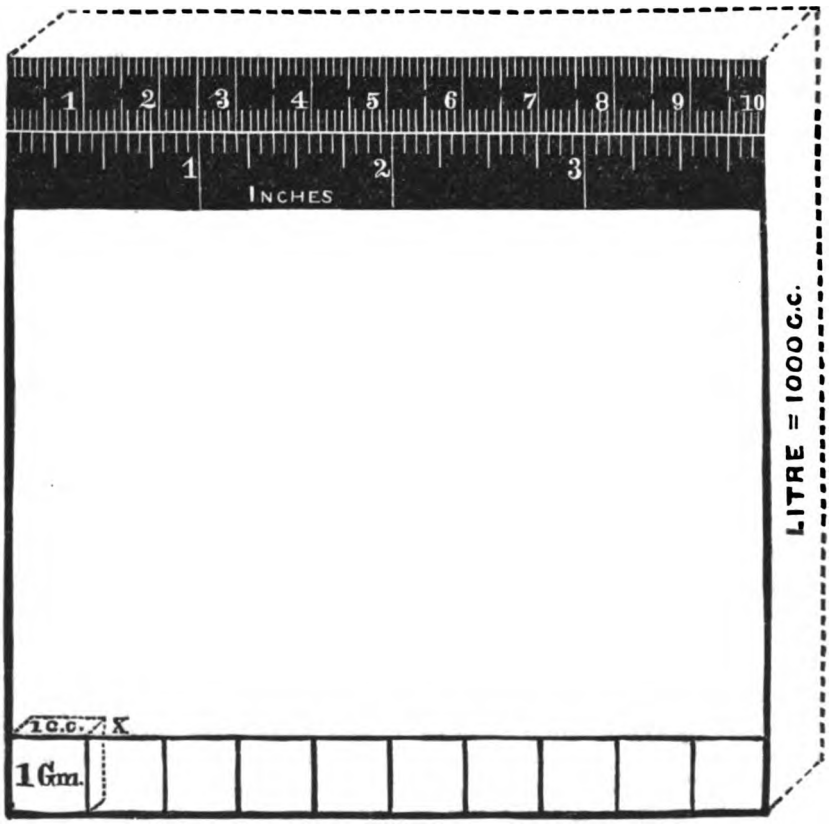
10000 Myriametre, Mm.	10000 Myrialitre, Ml.	10000 Myriagramme, Mg.
1000 Kilometre, Km.	1000 Kilolitre, Kl.	1000 Kilogramme, Kg.
100 Hectometre, Hm.	100 Hectolitre, Hl.	100 Hectogramme, Hg.
10 Dekametre, Dm.	10 Dekalitre, Dl.	10 Dekagramme, Dg.
1 **Metre**, M.	1 **Litre**, L.	1 **Gramme**, Gm.
.1 decimetre, dm.	.1 decilitre, dl.	.1 decigramme, dg.
.01 centimetre, cm.	.01 centilitre, cl.	.01 centigramme, cg.
.001 millimetre, mm.	.001 millilitre, ml.	.001 milligramme, mg.

In pharmaceutical practice a number of the above measures are rarely or never used. Of the measures of length, the *millimetre* (mm.) and *centimetre* (cm.) are employed in the U. S. Pharmacopœia in the descriptions of drugs, accompanied by the equivalent measure in inches or its fractions, whilst in microscopy, *micromillimetre* (mkm.), signifying the thousandth part of a millimetre, is sometimes used. In measures of capacity, the term *millilitre* is generally replaced by *cubic centimetre* (C.c.) in chemical and pharmaceutical practice, whilst it and the litre are alone chosen as the most convenient units. In weight, the *milligramme*, *centigramme*, *gramme*, and *kilogramme* are selected; the latter being the commercial unit for larger quantities of drugs, and called *kilo*. This habit of appropriating only certain of the most convenient denominations for practical work has an analogy in the disuse of the theoretical terms of the system of United States coinage: thus, the double-eagle, eagle, and dime are ignored, whilst dollars and cents are preferred as

[1] The unit of surface measure, the *are*, being the square of ten metres, and the unit of solid measure, the *stere*, having the capacity of a cubic metre, need not claim the attention of the practical pharmacist.

units. The principal merits of the metric system are: 1. That every weight and measure bears a simple relation to the initial unit, the metre. 2. That every unit is multiplied or divided by the same number (*i.e.*, 10) to obtain the various denominations, and increase or decrease is expressed by simply moving the decimal point. 3. Its almost universal adoption makes it an international system.

FIG. 1.



Metric diagram.

Length.—*Metre.* One side of the above square measures 1 decimetre; it is graduated into tenths (*centimetres*); and these into tenths (*millimetres*); (the scale beneath shows the comparison with inches): 10 decimetres = 1 METRE = 39.370432 in. (remember three threes, 3 ft., 3 in., 3 eighths).

Capacity.—*Litre.* A hollow cube having each side of the same size as the square would hold a LITRE = 1000 C.c. = 2.113433 pints.

Weight.—*Gramme.* The weight of distilled water at 4° C. (39.2° F.) contained in a cube of the size of X ($\frac{1}{1000}$ of a litre) is equal to a GRAMME = 15.43234874 grains, and measures 1 *cubic centimetre.*

Whilst the advantages of the metric system become more and more apparent upon examination, and its simplicity, brevity, and adaptability to every-day needs are universally conceded, the progress which it had made in this country up to 1883 did not warrant its exclusive adoption in the U. S. Pharmacopœia: hence, wherever definite quantities are mentioned, both metric and ordinary weights are named. The necessity for knowing thoroughly the denominations of all the systems in present use is one of the evils common to the age in which we live; and it must ever be a source of regret that when the young Republic, more than a century ago, abolished the complex system of coinage and adopted the decimal system, it did not go a step further and adopt the same principle in weights and measures.

The chief disadvantage of the metric system is one which inheres to the decimal principle of arithmetic,—namely, that the number ten cannot be divided more than once without producing a fraction, as, 10, 5, 2.5, 1.25, 0.625. The practice of dividing five into the three parts of 2, 2, and 1 partly compensates for this defect; and metric weights are constructed on this principle. The use of the metric weights and measures in the text of the U. S. Pharmacopœia makes it necessary for every pharmacist to become familiar with them, and therefore an easy method of remembering their relations to one another and their equivalents in other systems is desirable. The following equivalents are derived from those established by Congress for use in legal proceedings, or are based upon the trustworthy determinations of Captain Clarke and Prof. Miller, whilst the accompanying rules, which show the methods of using the equivalents, are preferred, on account of giving more accurate results. When very fine calculations are unnecessary, it will be found that the tables of equivalents given on pages 41 and 42 will prove sufficiently accurate for most pharmaceutical work.

To convert metric weights or measures into those in ordinary use:

RULE.—**Multiply the metric quantities by the corresponding equivalent.**

EX.—The equivalent of *one metre* is 39.370+ inches, and five metres would be 196.85 inches: $39.370 \times 5 = 196.85$. To convert

Metres	into *inches*,	multiply by	39.370
Centimetres	" *inches*,	"	0.3937
Millimetres	" *inches*,	"	0.03937

As *one litre*, or 1000 *C.c.*, is equal to 33.8149+ fluidounces, or 35.235 Imperial fluidounces, to convert

Litres	into *fluidounces*,	multiply by	33.815
Cubic centimetres	" *fluidounces*,	"	0.0338
Litres	" *pints*,	"	2.113
Litres	" *Imperial pints*,	"	1.7617
Litres	" *Imperial gallons*,	"	0.2202
Cubic centimetres	" *Imperial fluidounces*,	"	0.0352

As *one gramme* is equal to 15.432+ grains, or .03527 avoirdupois ounce, or .03215 troy ounce, to convert

Grammes	into	*grains,*	multiply by	15.432
Centigrammes	"	*grains,*	"	0.15432
Milligrammes	"	*grains,*	"	0.01543
Kilogrammes	"	*avoirdupois ounces,*	"	35.2739
Grammes	"	*avoirdupois ounces,*	"	.03527
Kilogrammes	"	*avoirdupois pounds,*	"	2.2046
Kilogrammes	"	*troy ounces,*	"	32.1507
Grammes	"	*troy ounces,*	"	.03215

To convert the weights and measures in ordinary use into metric weights and measures:

RULE.—**Multiply the quantities by the corresponding metric equivalent.**

As *one inch* is equal to 0.0254 metre, *one fluidounce* to 29.572+ cubic centimetres, *one Imperial fluidounce* to 28.3807 cubic centimetres, *one grain* to 0.0648 gramme, *one avoirdupois ounce* to 28.3495 grammes, and one *troy ounce* to 31.1035 grammes, to convert

Inches	into	*metres,*	multiply by	0.0254
Inches	"	*centimetres,*	"	2.5399
Inches	"	*millimetres,*	"	25.3997
Pints	"	*litres,*	"	0.4731
Fluidounces	"	*cubic centimetres,*	"	29.572
Imperial pints	"	*litres,*	"	0.5676
Imperial gallons	"	*litres,*	"	4.5409
Imperial fluidounces	"	*cubic centimetres,*	"	28.3807
Grains	"	*grammes,*	"	0.0648
Grains	"	*centigrammes,*	"	6.4799
Grains	"	*milligrammes,*	"	64.799
Avoirdupois ounces	"	*kilogrammes,*	"	0.02835
Avoirdupois ounces	"	*grammes,*	"	28.3495
Avoirdupois pounds	"	*kilogrammes,*	"	0.4536
Troy ounces	"	*kilogrammes,*	"	0.0311
Troy ounces	"	*grammes,*	"	31.1035

The equivalents given in the following tables are mostly approximations, and practically correct if they are properly used. Each figure is intended to refer only to its corresponding equivalent, with which it is connected by a mark of equality (=). It is not proper to use these equivalents to obtain larger quantities by multiplication. For instance, 30 C.c. is given as the equivalent for 1 fluidounce (the correct figure is 29.57 C.c.), but it would not be proper to multiply 30 by 80 if we wished to get the number of C.c. in 5 pints or 80 fluidounces of a liquid, because the difference between 29.57 and 30 would, when multiplied by 80, be too serious to overlook. The number of C.c. equivalent to 80 fluidounces is seen by the table to be 2365, whilst $80 \times 30 = 2400$, the difference being 35 C.c., or over a fluidounce.

Equivalents of United States and Metric Measures of Length.

Inches.		Millimetres.	Inches.		Millimetres.	Inches.		Centimetres.	Inches.		Centimetres.
1/25	=	1.00	5/8	=	15.85	1	=	2.54	7	=	17.78
1/12	=	2.11	3/4	=	16.92	2	=	5.08	8	=	20.32
1/8	=	3.17	7/8	=	19.05	3	=	7.62	9	=	22.86
1/4	=	6.35	15/16	=	21.15	4	=	10.16	10	=	25.40
1/3	=	8.46	1	=	22.19	5	=	12.70	11	=	27.94
1/2	=	12.70	1 1/12	=	23.28	6	=	15.24	12	=	30.48

Equivalents of Apothecaries' and Metric Fluid Measures.

Minims.		Cubic Centimetres.	Minims.		Cubic Centimetres.	Fluid-ounces.		Cubic Centimetres.	Fluid-ounces.		Cubic Centimetres.
1	=	0.06	25	=	1.54	1	=	**30.00**[1]	21	=	621.00
2	=	0.12	30	=	1.90	2	=	59.20	22	=	650.00
3	=	0.18	32	=	2.	3	=	89.00	23	=	680.00
4	=	0.24	35	=	2.16	4	=	118.40	24	=	710.00
5	=	0.30	40	=	2.50	5	=	148.00	25	=	740.00
6	=	0.36	45	=	2.80	6	=	178.00	26	=	769.00
7	=	0.42	50	=	3.08	7	=	207.00	27	=	798.50
8	=	0.50	55	=	3.40	8	=	236.00	28	=	828.00
9	=	0.55	Fluid-drachms.			9	=	266.00	29	=	858.00
10	=	0.60				10	=	295.70	30	=	887.25
11	=	0.68	1	=	**3.75**	11	=	325.25	31	=	917.00
12	=	0.74	1 1/4	=	4.65	12	=	355.00	32	=	946.00
13	=	0.80	1 1/2	=	5.60	13	=	385.00	48	=	1419.00
14	=	0.85	1 3/4	=	6.51	14	=	414.00	56	=	1655.00
15	=	0.92	2	=	7.50	15	=	444.00	64	=	1892.00
16	=	1.00	3	=	11.25	16	=	**473.11**	72	=	2128.00
17	=	1.05	4	=	15.00	17	=	503.00	80	=	2365.00
18	=	1.12	5	=	18.50	18	=	532.00	96	=	2839.00
19	=	1.17	6	=	22.50	19	=	562.00	112	=	3312.00
20	=	1.25	7	=	26.00	20	=	591.50	**128**	=	**3785.00**

[1] The more accurate equivalent is 29.57 C.c.

Equivalents of Metric Fluid and Apothecaries' Measure.

Cubic Centimetres.		Minims.	Cubic Centimetres.		Fluid-drachms.	Cubic Centimetres.		Fluid-ounces.	Cubic Centimetres.		Fluid-ounces.
0.05	=	0.81	5	=	1.35	**30**	=	**1.00**[2]	473	=	16.00
0.07	=	1.14	6	=	1.62	50	=	1.69	500	=	16.90
0.09	=	1.46	7	=	1.89	75	=	2.53	600	=	20.29
1	=	**16.00**[1]	8	=	2.16	100	=	3.38	700	=	23.67
2	=	32.4	9	=	2.43	200	=	6.76	800	=	27.05
3	=	48.6	10	=	2.71	300	=	10.14	900	=	30.43
4	=	64.8	25	=	6.76	400	=	13.53	1000	=	33.81

[1] Or, more exactly, 16 23.

[2] Or, more exactly, 1.01.

Equivalents of Avoirdupois and Metric Weight.

Avoir. Ounces.		Grammes.	Avoir Ounces.		Grammes.	Avoir. Ounces.		Grammes.	Avoir. Pounds.		Grammes.
1/16	=	1.772	5	=	141.75	13	=	368.54	3	=	1360.78
1/8	=	3.544	6	=	170.10	14	=	396.90	4	=	1814.37
1/4	=	7.088	7	=	198.45	15	=	425.25	5	=	2267.96
1/2	=	14.175	8	=	226.80	Avoir.			6	=	2721.55
1	=	28.350	9	=	255.15	Pounds.			7	=	3175.14
2	=	56.700	10	=	283.50	1	=	453.60	8	=	3628.74
3	=	85.050	11	=	311.84	2	=	907.18	9	=	4082.33
4	=	113.400	12	=	340.20	2.2	=	1000.00	10	=	4535.92

Equivalents of Metric and Avoirdupois Weight.

Grammes.	Oz.	Gr.	Grammes.	Oz.	Gr.	Grammes.	Oz.	Gr.	Grammes.	Oz.	Gr.
28.35 =	1		38 =	1	149	125 =	4	179	600 =	21	72
29 =	1	10	39 =	1	164	150 =	5	127	650 =	22	405
30 =	1	25	40 =	1	180	200 =	7	24	700 =	24	303
31 =	1	41	50 =	1	334	250 =	8	358	750 =	26	198
32 =	1	56	60 =	2	50	300 =	10	255	800 =	28	96
33 =	1	72	70 =	2	205	350 =	12	152	850 =	29	429
34 =	1	87	80 =	2	360	400 =	14	48	900 =	31	326
35 =	1	103	85 =	3		450 =	15	382	950 =	33	222
36 =	1	118	90 =	3	76	500 =	17	279	1000 =	35	120
37 =	1	133	100 =	3	230	550 =	19	175			

Equivalents of Apothecaries' and Metric Weight.

Grains.	Grammes.	Grains.	Grammes	Grains.	Grammes.	Drachms.	Grammes.
1/100 =	0.00065	1 =	0.065	24 =	1.55	1 =	3.9
1/80 =	0.00101	2 =	0.130	25 =	1.62	2 =	7.8
1/60 =	0.00108	3 =	0.195	26 =	1.70	3 =	11.65
1/50 =	0.00130	4 =	0.260	27 =	1.75	4 =	15.50
1/48 =	0.00135	5 =	0.324	28 =	1.82	5 =	19.40
1/40 =	0.00162	6 =	0.400	29 =	1.87	6 =	23.30
1/36 =	0.00180	7 =	0.460	30 =	1.95	7 =	27.20
1/32 =	0.00202	8 =	0.520	31 =	2.00	Ounces.	
1/30 =	0.00216	9 =	0.600	32 =	2.10	1 =	**31.10**[2]
1/25 =	0.00259	10 =	0.650	33 =	2.16	2 =	62.20
1/24 =	0.00270	11 =	0.715	34 =	2.20	3 =	93.30
1/20 =	0.00324	12 =	0.780	35 =	2.25	4 =	124.40
1/18 =	0.00360	13 =	0.845	36 =	2.30	5 =	155.50
1/16 =	0.00405	14 =	0.907	37 =	2.40	6 =	186.60
1/15 =	0.00432	15 =	0.972	38 =	2.47	7 =	217.70
1/12 =	0.00540	**15.5**[1] =	**1.000**	39 =	2.55	8 =	248.80
1/10 =	0.00648	16 =	1.040	40 =	2.60	9 =	280.00
1/8 =	0.00810	17 =	1.102	42 =	2.73	10 =	311.00
1/6 =	0.01080	18 =	1.160	44 =	2.86	11 =	342.14
1/5 =	0.01296	19 =	1.240	48 =	3.00	12 =	373.23
1/4 =	0.01620	20 =	1.300	50 =	3.25	14 =	435.50
1/3 =	0.02160	21 =	1.360	52 =	3.40	16 =	497.60
1/2 =	0.03240	22 =	1.425	56 =	3.65	24 =	746.40
3/4 =	0.04860	23 =	1.460	58 =	3.75	48 =	1492.80
						100 =	3110.40

[1] Or, more exactly, 15.432+ gr. = 1 gramme.

[2] Or, more exactly, 31.10349 grammes.

Equivalents of Metric and Apothecaries' Weight.

Grammes.	Grains.	Grammes.	Grains.	Grammes.	Grains.	Grammes.	Grains.
0.0010 =	1/65	0.065 =	1.003	1 =	15.43	100 =	1543.23
0.0020 =	1/32	0.100 =	1.543	2 =	30.86	125 =	1929.04
0.0040 =	1/16	0.130 =	2.006	3 =	46.30	150 =	2314.85
0.0065 =	1/10	0.150 =	2.315	4 =	61.73	175 =	2700.65
0.0081 =	1/8	0.180 =	2.778	5 =	77.16	450 =	6944.55
0.0108 =	1/6	0.200 =	3.086	6 =	92.60	550 =	8487.78
0.0162 =	1/4	0.300 =	4.630	7 =	108.02	650 =	10031.01
0.0324 =	1/2	0.500 =	7.716	8 =	123.46	750 =	11574.26
0.0486 =	3/4	0.700 =	10.803	9 =	138.90	850 =	13117.49
0.0567 =	7/8	0.900 =	13.890	10 =	154.32	1000 =	15432.35

ORTHOGRAPHY, PRONUNCIATION, AND READING.

Orthography.—There are two methods of orthography of the metric units in use in the United States: in one of these, the original French, the units are spelled metre, litre, gramme; in the other, proposed by the American Metric Bureau, the units are spelled meter, liter, gram. It would not be appropriate in a treatise of this kind to discuss the merits of either plan, but it is unfortunate that in the U. S. Pharmacopœia of 1880 the question was not settled, the French gramme having been retained and meter and liter adopted. As this compromise can only lead to confusion, the original orthography is preferred in this work, and it is used with one exception,—*i.e.*, *deca*, which is changed to *deka*, because *deca* could easily be mistaken for *deci*. In pharmacy particularly, *gramme* is to be preferred to *gram*, because in writing gram it could easily be mistaken for grain, particularly if the *i* in grain were not dotted.

Pronunciation.—Metre is pronounced mee'ter, litre lee'ter, gramme gram, not, as sometimes heard, gram'mee; centimetre should be pronounced sen'tee-mee-ter, not son'tee-mee-ter. The latter faulty pronunciation is quite common, and is due to confounding the French pronunciation with the English. Either son-tee-mā'tr (French) or sen'tee-mee-ter (English) would be correct, but to use half of the French and half of the English is obviously improper, and, as the metric system is now anglicized, the simple English pronunciation is less stilted and more appropriate.

Reading.—Some difficulty is usually experienced by those unfamiliar with the metric system in reading the quantities. In the linear measures in Pharmacy centimetres and millimetres are almost exclusively used: now, 0.05 m. would not be read five hundredths of a metre, but 5 centimetres (5 cm.); if the millimetre column contains a unit, as in 0.055 m., it is read fifty-five millimetres (55 mm.), in preference to fifty-five thousandths of a metre; or it is sometimes read five centimetres and five millimetres.

Fractions of a millimetre must be read decimally, as, 0.0555 m., fifty-five and five-tenths millimetres. In measures of capacity, cubic centimetres are exclusively used; if the quantity is less than a litre, the terms half litre, quarter litre, decilitre, centilitre, millilitre, are replaced by 500 C.c., 250 C.c., 100 C.c., 10 C.c., 1 C.c.; in aqueous liquids the cubic centimetre is considered equivalent to a gramme. In weight, when the quantity is relatively large, and in commercial transactions, the kilogramme is abbreviated to kilo, pronounced kĭl'o; when less than a kilogramme, and not less than a gramme, the quantity is read with the gramme for the unit; 2000 Gm. would be read two kilos, and 543 Gm. would be read five hundred and forty-three grammes, whilst 2543 Gm. is usually read two kilos and five hundred and forty-three grammes, although twenty-five hundred and forty-three grammes is sometimes preferred. For quantities below the gramme, decigrammes are not used, but centigrammes and milligrammes are regarded as the most convenient units: they are read in the same way as centimetres and millimetres.

Weighing and Measuring.

Among the first operations that the student is called upon to perform are the very important ones of *weighing* and *measuring*. The former process requires the use of the *balance*, or, as more frequently, but less preferably, termed, *scales*. As the successful performance of many of the processes noticed in this work depends upon a thorough knowledge of the principles of the balance, it has been selected as one of the first subjects for consideration, for this instrument in some form or other is relied upon to secure accurate quantities of the substances employed in the various operations of pharmacy.

The balance may be defined as an instrument for determining the relative weights of substances, and should be *correctly constructed, skilfully used*, and *carefully protected from injury*, if accurate results are expected.

CONSTRUCTION OF THE BALANCE.—For systematic consideration pharmaceutical balances may be classified as follows: 1. *Single beam, equal arms.* 2. *Single beam, unequal arms.* 3. *Double beam, unequal arms.* 4. *Compound lever balances.* 5. *Torsion balances.*

1. Single Beam, Equal Arm Balances.—The instrument which, notwithstanding many attempts to supplant it, still maintains its supremacy is the *single beam, equal arm balance*, which may be described as consisting of a metallic lever or beam, divided into two equal arms at the centre by a knife-edge, upon which it is suspended. At exactly equal distances from the point of suspension, and situated in the same plane, are placed the end knife-edges: these support the pans which carry the substances to be weighed. A good balance should possess the following requirements:

1. *When the beam is in a horizontal position, the centre of gravity should be slightly below the point of suspension, or central knife-edge, and perpendicular to it.*

The relative sensibility of the balance depends upon the fulfilment of this principle, which may be roughly illustrated by forcing a pin through the centre of an oblong piece of pasteboard: if the edge of the pasteboard is touched slightly it does not oscillate at all, but revolves around the centre to a degree corresponding to the impulse representing equilibrium; if the pin be removed and inserted a very short distance above the centre, and the edge of the pasteboard touched as before, it will oscillate slowly, corresponding to a sensitive beam, the point of suspension slightly above the centre of gravity; if the pin be again removed and inserted far above the centre, and the same impulse imparted to the edge, it will oscillate quickly, illustrating stable equilibrium and a beam which comes to rest quickly and is not sensitive. A more elaborate method of illustration is furnished by the use of a beam with a movable fulcrum (see Fig. 2), when the relative position of the knife-edge may be made to show, beginning at the top, 1, stable equilibrium; 2, in the centre, equilibrium; and, 3, when the lowest point is reached, unstable equilibrium, and then the slightest impulse upsets the beam.

2. *The end knife-edges must be at exactly equal distances from the*

central knife-edge; they must all be in the same plane, and the edges absolutely parallel to each other.

It is very apparent that the conditions of a good prescription balance cannot be satisfied if there is inequality in the length of the arms of the

FIG. 2.

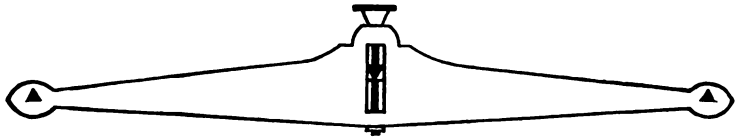
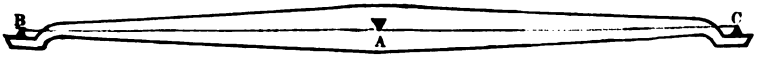


Illustration of equilibrium.

beam. In Fig. 3, BA should equal AC, otherwise unequal weights would be required to establish equilibrium, or the excess of weight of the longer arm must be subtracted at every weighing, or weighing by substitution resorted to, all manifestly impracticable. If the central knife-edge be placed either above or below a line drawn so that it connects the end knife-edges, the loading of the pans will either cause the beam to

FIG. 3.



Position of knife-edges.

cease oscillating, or diminish the sensibility in proportion to the load. If the knife-edges are not parallel, the weight of a body would not be constant upon every part of the pan, but would be greater if placed near the edge on one side, and correspondingly less at a point directly opposite.

3. *The beam should be inflexible, but as light in weight as possible, and the knife-edges in fine balances should bear upon agate planes.*

Rigidity of the beam is necessary, because any serious deflection caused by a loading of the pans would lower the end knife-edges, and thus accuracy in weighing would be impossible. The beam should not be heavier than necessary, because its sensibility (particularly when light weights were placed upon the pans) would be thereby lessened, and to diminish friction arising from the rusting of the steel knife-edges which constantly increases with the age and use of a balance, the bearings of the knife-edges should be agate planes. Formerly this condition could not be practically carried out, except in expensive balances, owing to the cost of polished agate; but since the introduction of automatic machines for grinding and polishing this very hard substance, the cost has been so reduced that not only the bearings, but the knife-edges themselves, are now made of agate and used upon fine prescription balances, and it is practical economy to employ exclusively those so mounted.

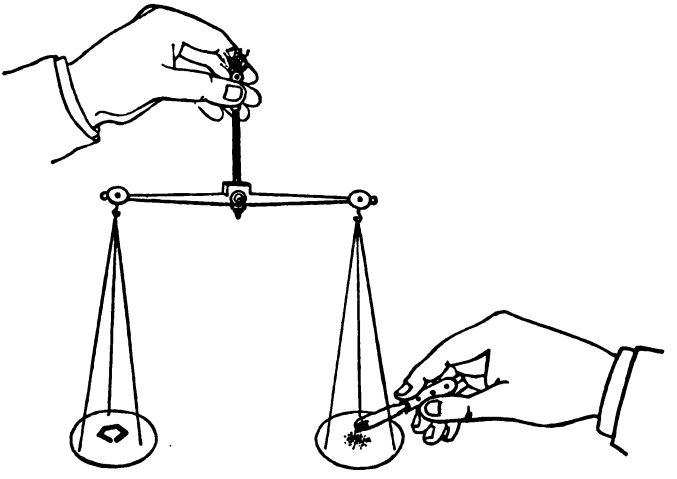
The Tests of a Balance.—Having stated the essential points in the construction of the balance, the tests, which should always be applied before accepting a balance, will now be described. The prescription balance, being one of the most delicate and important of the instruments

in use by the pharmacist, is selected for illustration. 1. A perfectly level counter or table is secured, the balance is placed in position, the beam elevated so that it is free to oscillate, and when the oscillations have ceased, the smallest weight to which the balance is sensitive is placed upon the right-hand pan,—it should at once respond to the weight; this tests its sensibility with unloaded pans. 2. Both pans are now loaded with the full weight that the balance is designed to carry, and then the smallest weight is placed upon the right-hand pan,—the oscillation, although slower than in the first test, ought to be as decided; this shows its sensibility when loaded. 3. The pans should now be loaded to half the capacity of the balance, and equilibrium perfected by adding, if necessary, a piece of tin-foil. The weights on the right-hand pan must now be exchanged for those on the left-hand pan, and *vice versa;* if equilibrium is still maintained, *the arms of the beam are equal.* 4. The pans should be moderately loaded and balanced, and one of the larger weights shifted in different positions upon the edge of one of the pans, and any variation in equilibrium carefully noted. This variation, as previously mentioned, indicates a want of parallelism in the knife-edges.

Forms of Single Beam, Equal Arm Balances.—There are good reasons for believing that this kind of balance has a very ancient origin; and at the present time it is used more frequently than any other.

Hand Scales.—The commonest form in which this principle is utilized in pharmacy is seen in the cheap hand scales now fast passing out of use; in the better qualities the beam is of steel, and the knife-edges are enclosed so as to protect them from injury. In those usually seen the

FIG. 4.



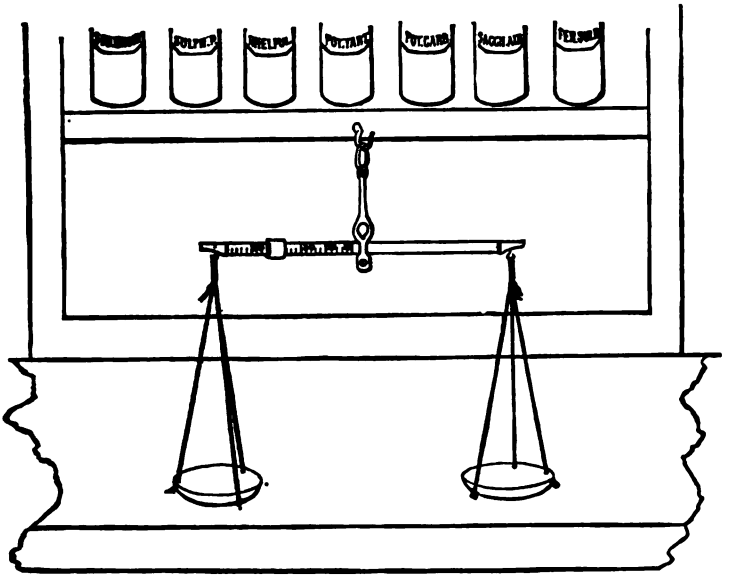
Manner of holding scales.

beam is of brass, with a steel central knife-edge, having a perforation in each end of the beam for the insertion of two wire hooks, to which are attached silken cords for supporting the pans. The manner of holding these scales is shown in Fig. 4. They are now most largely employed in

America by physicians and pharmacists having a very limited use for a balance. The silken tassel is held in the left hand, and care should always be taken *to see that the beam oscillates freely and properly* before the weight is placed upon the left-hand pan, as the hooks frequently become entangled in the cords and the adjustment is lost. The requisite quantity of the substance to be weighed is placed upon the right-hand pan, preferably with a spatula.

Alkaloids and very poisonous substances should never be weighed upon ordinary hand prescription scales, except when, by previous actual test at the time, they have been shown to be sensitive and accurate; for, although this form has been in use many years, as now found in commerce they are the most unreliable of all kinds of prescription balances, and, notwithstanding their merits of cheapness and portability, in the end they may prove (through some serious error) an expensive investment. In Fig. 5 is shown an improved form of hand scale in which a sliding weight is used; this may be suspended on a hook at the proper height as shown in the cut.

FIG. 5.



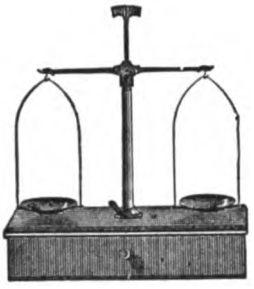
Hand scale with sliding weight.

Prescription Balances.—The advantage of substituting a rigid metallic column for the usually unsteady human arm, as a support to the beam, would seem to be apparent at a glance, for, in addition to the increased stability which is gained, both hands are left free to perform the weighing; more time can usually be devoted to secure equilibrium, and the oscillations can be more readily noticed.

A cheap form of prescription balance, called, technically, the army prescription scales (Troemner), is seen in Fig. 6; the beam, column, supports, pan, etc., are of brass, the knife-edges of steel, whilst the

drawer beneath is large enough to hold conveniently all the parts; this is a very useful feature where a balance is not in constant use, enabling the operator to set the balance at will, or keep it in the drawer protected from dust and corrosion. It may be made sensitive to the $\frac{1}{24}$ of a grain; but it soon loses this degree of delicacy, because of the rusting of the steel bearings and knife-edges. With careful handling, and by protecting it from the atmosphere by covering with a glass shade, it will remain in good order for years, and is vastly superior to the hand prescription scales.

FIG. 6.

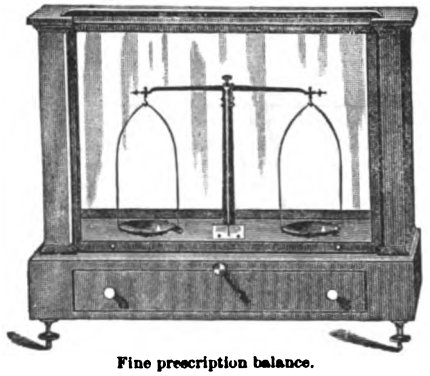


Army prescription scale.

A pharmacist who desires to make use of all the modern improvements and secure the best practical results, should have, for *economy's* sake, *two* prescription balances,—one for delicate weighings and the other for ordinary work. These need not have the most fashionable and costly *cases*, but the workmanship of the balance itself cannot be too fine, if by it are secured the absolute essentials of accuracy, sensibility, and durability.

In addition to the theoretical requirements before noted, the finest prescription balances now made by Troemner are provided with solid silver pans and gold-plated beams (see Fig. 7). As the pans are subjected to more wear and tear than any other part of the balance, it is economical to use *solid* rather than *plated* pans, for, as they have to be cleaned repeatedly, constant friction wears off the plating, and the additional cost for replating soon absorbs the difference in price. To secure the best results, when a showy appearance is not desired, a dead-black finish to the column is preferable, as the labor of polishing, with the danger to the adjustment that it involves, is dispensed with. If the supports and pans are of silver, the knife-edges of iridium, and the bearings of agate, a prescription balance is furnished which is durable and really cheap, because it is fully equal to the most exacting demands.

FIG. 7.

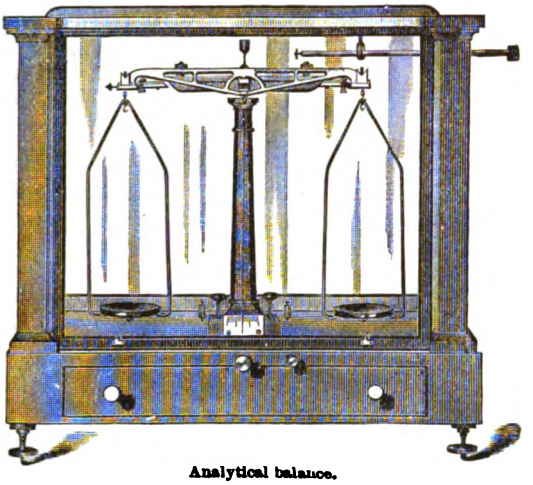


Fine prescription balance.

Analytical Balances.—The growing importance of analytical work, in connection with the quantitative tests introduced into the last revision of the U. S. Pharmacopœia, renders the possession of an analytical balance by the pharmacist very desirable. Formerly these delicate objects of mechanical skill were exclusively imported, but for twenty years American manufacturers have devoted unremitting effort to excelling in this fine work, with gratifying success. Fig. 8 shows an analytical balance of recent pattern. The open, metallic beam is made of a com-

position of 90 per cent. of nickel and 10 per cent. of silver, and in the finest grades both the knives and bearings are of agate. The ends of the stirrups are provided with hooks to suspend a body in taking its specific gravity, and a contrivance for arresting the motion of the beam and pans, together with one for elevating the beam entirely from contact with the agate planes when not in use, is provided.

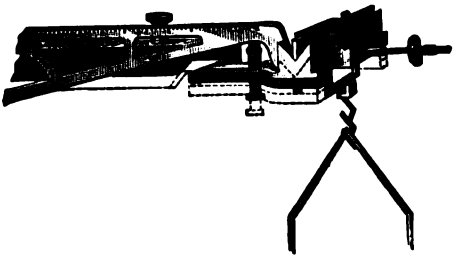
FIG. 8.



Analytical balance.

Fig. 9 shows an enlarged view of the end of the beam with the beam locked; the dotted lines show the position of the lever when the beam is permitted to oscillate. The right arm of the beam is graduated so that each division represents one-tenth of a milligramme if metric weights are used, or one-hundredth of a grain if apothecaries' weight is employed; an aluminium-wire rider is pushed along the arm by a sliding rod to any point upon the graduated beam to indicate these fractions. An index needle traverses an ivory scale fixed on the base of the column, and the most delicate oscillations may be thus measured by the needle: if, for instance, *one-tenth of a grain* on one of the pans deflects the needle *ten* divisions on the scale, each one of these divisions would then represent one-tenth of the weight on the pan, or one-hundredth of a grain. With practice, the use of this means of weighing very minute quantities can be brought to great perfection.

FIG. 9.

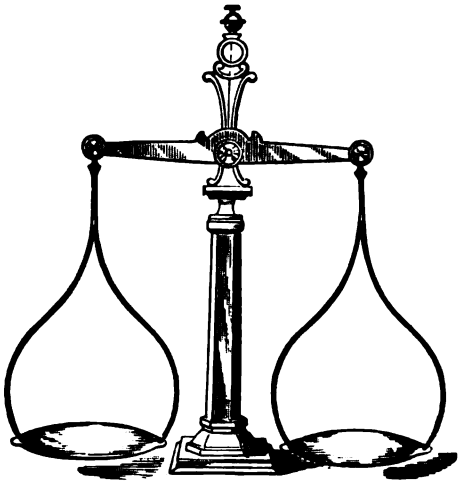


End of the beam of analytical balance.

Counter Scales.—For counter and dispensing purposes, the single beam, equal arm principle was formerly exclusively used (see Fig. 10). These scales were usually made of polished brass, and answered most purposes if kept in good order, but were objectionable because the pan-supports were frequently obstructive, as they only permitted the weighing of bodies having a limited surface, and the excessive amount of polished brass-work about them required the expenditure of considerable labor to keep them bright, without any corresponding advantage. The form in which the pans are placed above the beam, thus getting rid of obstructive

pan-supports, is now greatly preferred. A cheap form is seen in Fig. 11. In these the objection to the polished brass is met by japanning the beam and weight-pan to protect them from rust; the copper or brass pan alone needs polishing, but the knife-edges and bearings require careful cleaning from time to time if their original sensitiveness is to be even approximately retained. A very convenient form of dispensing scale for smaller weights, made by Troemner, is shown in Fig. 12. This beam is provided with a parallel, graduated, nickel-plated bar, upon which a poise slides backward and forward; this is particularly useful for weighing liquids. The tare of the bottle is easily taken by the use of the sliding poise, the beam is graduated so that apothecaries' or metric weight may be used, and a projecting shelf attached to the base forms a convenient receptacle for the weights.

FIG. 10.

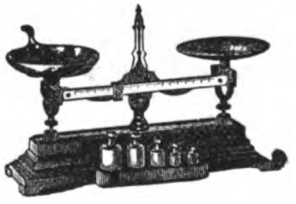


Old-style counter scales.

FIG. 11.

Common counter scales.

FIG. 12.



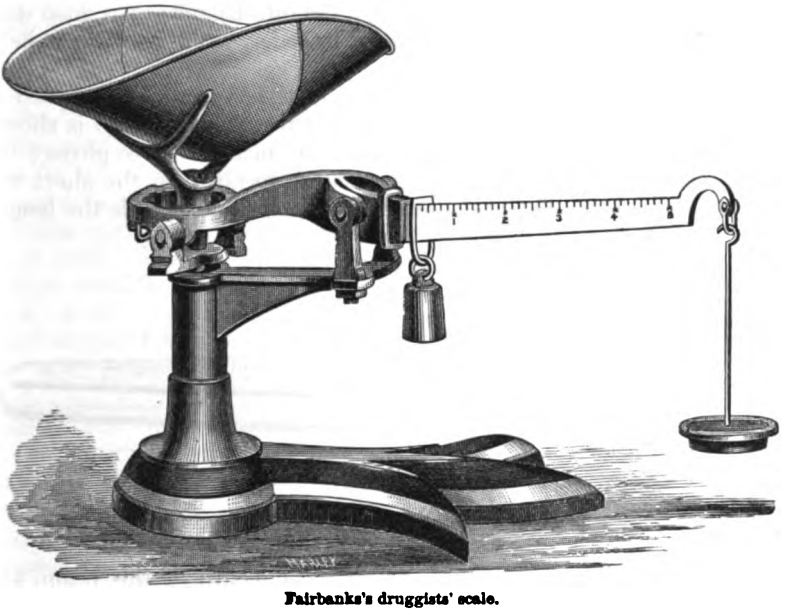
Scale with graduated parallel beam and sliding weight.

2. Forms of Single Beam, Unequal Arm Balances.—The principle upon which these very practical weighing machines are founded is best shown by referring to Fairbanks's druggists' scale (see Fig. 13), and quoting the law in physics, "*The power is to the weight or resistance in the inverse ratio of the length of the arms of the lever.*" The inequality in the length of the arms of this beam permits of the convenient use of one movable weight upon the graduated longer arm of the beam, and thus dispensing with the use of small weights, which are liable to be lost; the scoop, which is useful in weighing bulky drugs, is sometimes replaced by a flat, circular disk when bottles, etc., are to be weighed.

The principle of the graduated beam has been utilized by Fairbanks to make a very simple and convenient prescription scale, by the use of which detached weights are dispensed with (see Fig. 14). A nickel-

plated beam is suspended nearly in the centre, at one end of which a pan-support is attached, carrying a nickel-plated pan; the arm of the

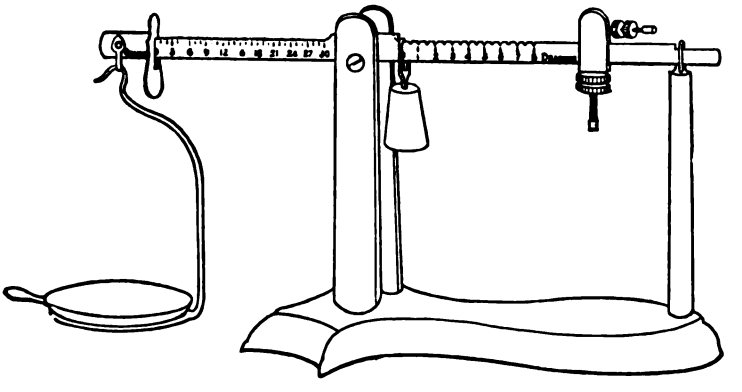
FIG. 13.



Fairbanks's druggists' scale.

beam nearest to the pan is graduated into thirty divisions and marked *grains;* a small sliding weight is used upon this arm; the other arm is graduated only about half its length, and the divisions represent *drachms.* A heavier sliding weight is used here to indicate drachms,

FIG. 14.



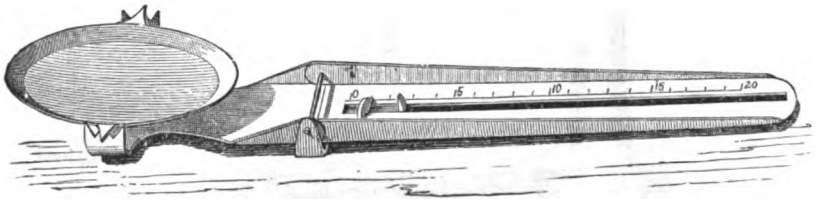
Graduated beam prescription scale.

and at the other end of the arm there is attached a weight, which is fastened to the beam by adjusting screws; this may be moved backward

or forward and set, and is for the purpose of maintaining equilibrium in case the beam should need rebalancing at any time; the end of this arm moves freely up and down in the wire loop on the upright at the end of the base. This scale is not intended for very accurate weighing, but it serves the purpose of relieving a delicate balance of a good deal of heavy wear and tear; it will, if kept in order, weigh as little as half a grain.

A very simple vest-pocket prescription scale is made by Shepard & Dudley, of New York; it is on the unequal arm principle, and is shown *full size* in Fig. 15. The principal parts are made in three pieces; the pan is detachable, the pan-support being suspended on the short rod attached to the base; the graduated beam is more than double the length

FIG. 15.



Vest-pocket prescription scale.

of the pan-support, a slot running nearly the length of this beam, and a sliding weight is pushed along in the slot. The scale is very cheap, and is intended for country physicians, who are often compelled to weigh medicines at the bedside of the patient.

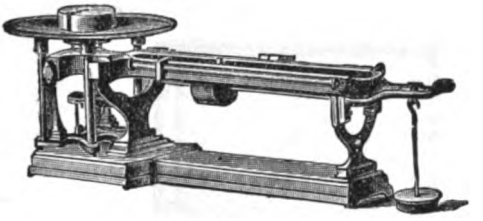
3. Double Beam, Unequal Arm Balances.—It is preferable to have a double beam scale for constant use in the laboratory, and the most convenient form is upon the same principle as Fairbanks's druggists' scale (Fig. 13), having, however, two parallel beams. This scale is particularly adapted for weighing liquids, the weight on the outside beam being used to tare the bottle or jar, whilst the other weight is left free so that it can be adjusted at once to the weight of the liquid desired. These are now to be had with the scale graduated into grammes, and are very useful in making preparations by the system of "parts by weight" of the U. S. Pharmacopœia, 1880. (See Fig. 16.)

4. Compound Lever Balances.—The principle of the compound lever was first applied in the construction of balances by Robervahl, of Paris, about A.D. 1660. It has only been recently adopted for delicate weighings in compounding prescriptions, although the general utility of counter and platform scales constructed upon this plan has long been recognized. The principal objection to them, when compared with equal beam balances, consists in the multiplicity of points of suspension, thus necessarily increasing friction and the liability to disarrangement; but their general convenience, and some recent improvements in their construction, have brought them into favor. The principle of the Robervahl compound lever balance, with the arrangement of the levers, is shown in the glass box scale in Fig. 17.

One of the practical advantages possessed by this form of balance is the small amount of polished metal to keep in order, and, as the working parts are enclosed in a tight box of glass, wood, or marble, dust and corrosive vapors are largely excluded; as they are made to occupy as little space as possible, the pans are conveniently low and unobstructed.

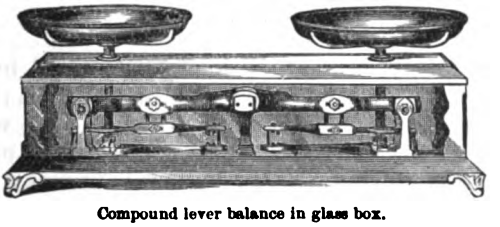
Box prescription scales, on the compound lever principle, have come into extensive use, and they are the most convenient scales for weighing moderately small quantities (see Fig. 18). Although sensitive to $\frac{1}{30}$ of a grain when new, they do not retain this delicacy long. Their strongest recommendation is the ease with which they may be cleaned and kept in order; the only polished metal liable to be affected by corrosive vapors is found in the pans, and these are nickel-plated; the marble top has a countersunk basin to keep weights in, and a hinged glass cover effectually excludes dust and vapors when the balance is not in use. If a pharmacist has a delicate, equal beam balance for weighing alkaloids and powerful poisons (see Fig. 7), and a box prescription scale for weighing ordinary quantities, he is well equipped for compounding prescriptions.

FIG. 16.



Troemner's scale for weighing liquids.

FIG. 17.



Compound lever balance in glass box.

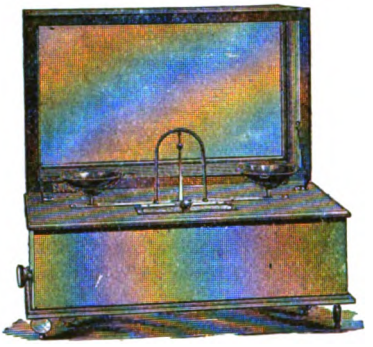
By far the most extensive application of the compound lever and unequal arm principles has been made in the universally known platform scales, which are manufactured largely by Fairbanks and others; these are employed in weighing comparatively large quantities, and are most useful in the laboratory and warehouse. In these a platform or table is suspended by four short legs upon the ends of four levers, which are joined to a central nearly horizontal lever, which in turn is connected with a perpendicular iron rod attached to the graduated bar, suspended so that one of the arms is much longer than the other. This combination of levers is so nicely adjusted that one hundred pounds placed upon the platform may be balanced by a one-pound weight placed upon the end of the graduated bar.

FIG. 18.

Box prescription scale.

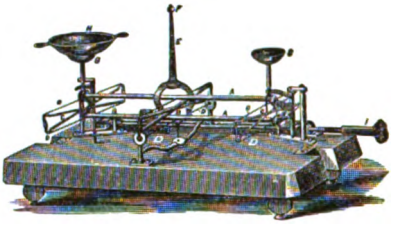
Torsion Balances.—In 1882 a prescription balance constructed upon a novel principle was introduced, and attracted attention at once. This ingenious balance was contrived by Prof. Roeder and Dr. Springer, of Cincinnati. (See Figs. 19 and 20.) Knife-edges are entirely done away with. A compound beam, AA, is balanced and supported upon an immovable centre frame, B, upon which a flattened gold wire, D, is stretched with powerful tension; the beam is prevented from slipping

FIG. 19.



Torsion balance.

FIG. 20.



Torsion balance (inside view).

out of place, and the torsion is secured by the gold wire being firmly fastened to the under side of the beam; upon the ends of the beam are fastened the movable frames, CC, which support the pans, H. There is a simple method of arresting the motion by moving the lever, I, and the delicacy of the balance is increased by placing a weight, F, upon the index, whereby the centre of gravity is elevated.

Care of the Balance.—The necessity for protecting the delicate mechanism of a balance is frequently overlooked, notwithstanding the possibility of having a fine apparatus irretrievably ruined by want of care in using or cleaning it or in protecting it whilst at rest. The position chosen for the balance or scales should be upon a level and firm counter, desk, or table, where it will be subjected to little risk of injury from dampness, dust, or corrosive vapors, and where the knife-edges will not be liable to become blunted by the jarring produced by heavy mortar-practice or other vibration.

In the finer class of balances protection is afforded by enclosing them in glass cases having sash doors in the front or at the side, and providing against injury from vibration by the use of a lever for elevating or locking the beam, so that the knife-edges are not in contact with any surface whatever. To prevent injury from jarring whilst the balance is in use, by a weight falling on the pan or other accident, the finest balances are provided with pan-supports, which break the fall and serve the additional purpose of quickly arresting the beam, thus saving time whilst weighing.

Substances which act on metals, like iodine, corrosive sublimate, etc., and those which are adhesive, like the extracts, should not be weighed directly upon the scale-pans, but upon the glass pans which are furnished

by the manufacturers, or, if these are not at hand, upon highly-glazed paper, care being taken to balance the papers before weighing the substance. In cleaning the scales, great care should be exercised; polishing powders should be used sparingly; a portion is very apt to find its way into crevices and elude detection until an attempt is made to adjust the scales, when the increased weight of one of the sides of the beam leads to its discovery. Frequent cleaning with soft leather is generally sufficient to keep a balance in good order; but if through neglect it becomes necessary to use more active measures, some simple polishing powder for the silver and brass work, with soapsuds for nickel-plate, and simple brushing for the lacquered brass, is all that is necessary.

METALLIC WEIGHTS USED IN PHARMACY.

The weights used by the pharmacist are a very important part of his outfit, and care in their selection and examination is more than ever necessary since the adoption of the principle of parts by weight in the U. S. Pharmacopœia, 1880.

Common avoirdupois weights are usually made of iron, and are of the flat, circular form (see Fig. 21), japanned to prevent rusting; these form a pyramidal pile, and range from half an ounce to four pounds; they may be adjusted by adding to or diminishing the amount of lead which is hammered into a depression in the base of each. These weights are sometimes made of brass in this form, and sometimes of zinc: the latter, however, are brittle and unserviceable. When used for dispensing purposes, the cylindrical weights, known technically as "block weights," are preferable. If the block is made of two kinds of wood glued together, so as to avoid shrinkage, they are very desirable, particularly if each cylindrical hole in the block has been made large enough to hold easily each weight. The advantages of block weights are, that the gaps left by missing weights are readily noticed, and the greater surface of the weight is protected from the action of corrosive vapors when not in use. When the weights are nickel-plated, a more imposing appearance is produced by arranging them on an ebonized block in recesses. The disadvantage of this form is that the surfaces are not protected from oxidation, and they need cleaning more frequently. J. M. Maris & Co., of Philadelphia, supply brass avoirdupois weights having a shoulder near the top; these fit into circular openings in a hollow cast-iron frame (see Fig. 22), and by this expedient the annoyance common to ordinary blocks, caused by the shrinkage of the wood, is avoided.

FIG. 21.

Common avoirdupois weights.

FIG. 22.

Avoirdupois weights in metal frame.

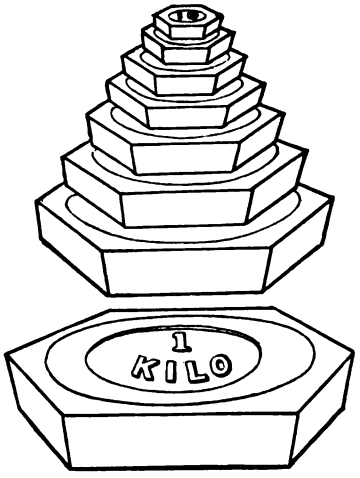
Troy weights may be had either as "block weights" or "cup weights;" the latter are to be preferred, particularly if the block avoirdupois weights have already been procured, for they are then easily distinguished from each other. The cup troy weights range from quarter of an ounce to thirty-two ounces, and have many conveniences (see Fig. 23). When the outside weight is separated, it will be found to have the exact weight of all the rest; if one of the weights is missing, its absence is at once noticed in the incomplete nest; and their compact form is a great recommendation. Weights cannot well be made to occupy less space; whilst all the inside weights are protected from abrasion and corrosion.

FIG. 23.

Troy weights.

Metric weights may be procured of iron (japanned) for coarse weighing, when they are preferably hexagonal and flat in shape, to distinguish them from the ordinary round avoirdupois weights (see Fig. 24). The most useful for the pharmacist's purposes are undoubtedly the brass weights. Those made by Becker, and contained in a solid block, ranging from one centigramme to one hectogramme, as shown in Fig. 25, are very reliable and convenient.

FIG. 24.



Metric weights (iron).

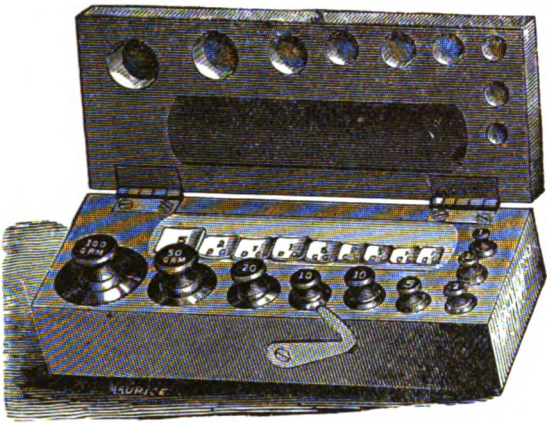
For prescription purposes, a very inexpensive yet accurate set is made by Troemner, by which as high as forty grammes may be weighed by using all the brass weights, whilst ample provision is made for weighing the fractional parts of a gramme.

For analytical purposes, metric weights are almost exclusively used; in the most complete sets the highest weight is one kilogramme, the lowest one-tenth of a milligramme; three riders for use on the graduated scale beam are provided. The weights from one gramme upward are of brass, finely lacquered; the smaller weights are made of squares of platinum-foil, curved so as to permit of being easily handled with the forceps (see Fig. 26).

Prescription Weights.—Too much care can hardly be exercised in the selection of weights to be used in compounding prescriptions. The cost of accurate weights is trifling, yet the market is flooded with weights which are disgracefully inaccurate, and it is greatly to be regretted that the latter find a ready sale. The round, flat, brass "drachm" weights, which have the denomination stamped distinctly on their face in raised characters, are most largely used: these range from ten grains to one hundred and twenty grains in weight. The old-fashioned square brass "drachm" weights are rapidly passing out of use. The brass-foil grain weights are usually inaccurate, and should not be employed, because of their liability to corrosion. Undoubtedly the best grain weights are the aluminium wire weights: these are more easily and quickly distinguished

from one another than any other form, and there is less likelihood of dangerous mistakes than from the flat weights, where the denomination is stamped upon the face, often faintly, and is liable to be obliterated

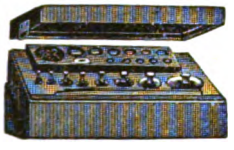
FIG. 25.



Metric weights (block).

by constant use or corrosive contact. The number of sides in the wire weights at once gives the denomination (see Fig. 27). There is such a

FIG. 26.



Metric weights (analytical).

FIG. 27.

Aluminium wire weights.

difference in the shape of these weights, and they are so simply handled practically, that they should be invariably used. The aluminium grain weights, cut out of aluminium plates, are to be preferred to the flat, brass grain weights, because less liable to corrosive action. They are usually more accurately adjusted; the corners of the weights are clipped, and each weight is pressed into a curved form, so that it may be easily picked up (see Fig. 28).

FIG. 28.

Aluminium grain weights.

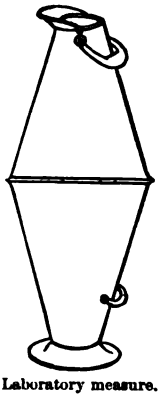
Measuring Liquids.—Tinned iron measures nearly cylindrical in shape, but slightly wider at the bottom, are generally used for measuring liquids when the quantity is over a pint. A set of these measures usually consists of four (gallon, half-gallon, quart, and pint). Those made of tinned iron, or of the enamelled sheet-iron called agate or marbleized, are greatly inferior to those made of *tinned copper*. Tinned iron measures

soon become rusty; and although a protection is afforded if enamelled, particles of the enamel become chipped off, and the exposed iron soon contaminates the liquids measured in them. Tinned copper measures cost more at first, but they are more economical, because more durable. Care must be taken to protect them from blows which will cause dents, as these may be serious enough to detract from the accuracy of the measures. Fig. 29 shows a useful combination of a measure and funnel. Cylindrical metric measures having a diameter just half their height, of tinned copper or brass, in sets of ten, including dekalitre, half-dekalitre, double litre, litre, half-litre, double decilitre, decilitre, half-decilitre, double centilitre, and centilitre, are furnished by the American Metric Bureau. An excellent measure for the laboratory, particularly where liquids are to be carried any distance, is shown in Fig. 30. It is used by Dr. E. R. Squibb, and has the merit of being less liable to error

FIG. 29.

Combined measure and funnel.

FIG. 30.



Laboratory measure.

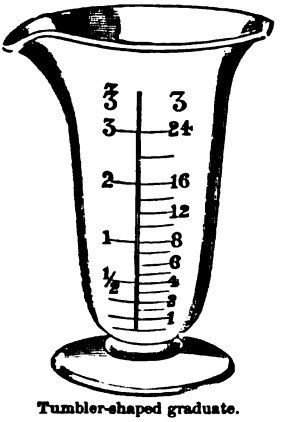
in measuring than those of ordinary shape, because of the contracted surface at the top.

Glass measures are preferred for relatively small quantities of liquids, for, although always subject to loss by fracture, they can be more accurately adjusted to indicate the measure. On account of the transparency of glass, the level of the liquid at any height may be seen through the measure, whilst porcelain or metallic measures have to be full, or nearly so, to be used.

Glass graduated measures are almost exclusively used for quantities of one pint or less, and these are of two forms,—*conical* and *cylindrical*. The conical graduate is preferred in practical work because of the greater ease with which it can be cleansed, but cylindrical measures are likely to be more accurate because of their smaller diameter: thus, if a conical graduated measure has at the f℥3 mark a diameter of 3 inches (see Figs. 31 and 32), and the cylindrical graduate a diameter at the same mark of 1 inch, it follows that a trifling error in reading off in the cylindrical graduate, either slightly above or below the line, would be increased if similarly made in the conical graduate by exactly the number of times that the surface of the conical graduate exceeds that of the cylindrical

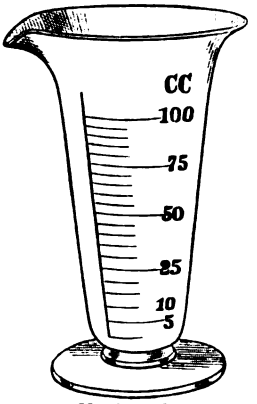
graduate at the given point (see Fig. 33). Formerly it was usual to use exclusively glass measures which had been graduated by hand; but, owing to the large quantities of imperfect graduates found in the

Fig. 31.



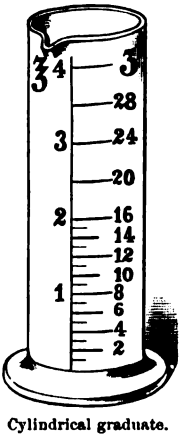
Tumbler-shaped graduate.

Fig. 32.



Metric graduate.

Fig. 33.



Cylindrical graduate.

market, moulded measures came into use: these, whilst deficient in the attractive brilliancy of surface characteristic of blown glass, have the substantial merit of greater accuracy. Hodgson's moulded graduated measures were the first to appear, and were largely used for a while, but they have been supplanted by Hobb's graduated measures. In Hodgson's measure the graduations are upon the outside surface of the glass, and their accuracy largely depends upon whether the plunger, which forces the melted glass into the mould, is driven down to exactly the standard depth to secure the proper thickness of glass to indicate the correct capacity: this practical point could not always be attained, owing to the wear of the mould, and occasionally the measures were imperfect. In Hobb's graduated measures this difficulty is overcome by *graduating the plunger*, and when this is done it makes no difference about the thickness of the glass, because if the plunger is correctly graduated, if the proper allowance has been made for contraction in cooling, and if a correct impression can be made upon the inside of the glass, the measure itself must be accurate, and the same result can be indefinitely repeated. An objection arises, however, to this form of graduate in measuring thick or dark-colored liquids, for then the graduations upon the inside are often completely obscured: this is sometimes remedied by correspondingly marking them upon the outside with an engraver's wheel. The introduction of the moulded graduates has had the natural effect of improving the accuracy of the blown, hand-graduated measures, and it is now unusual to see a measure like one formerly in the possession of the author, which registered 25 per cent. too much when filled to the highest graduation. If the custom of returning to the maker all graduates which prove inaccurate were universal, it would soon be impossible to find an inaccurate one: as it is, reliable graduates can always be had by paying a fair price for them.

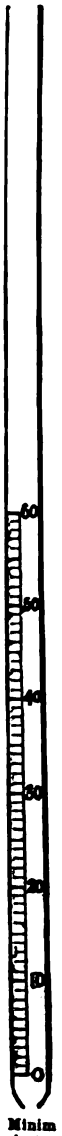
An improvement has been made recently by graduating measures *doubly;* upon one side metric measures are marked, and upon the other ordinary fluid measures, and in addition they sometimes have two lips opposite to each other, for pouring either to the right or left, or for permitting the use of either scale. The testing of the graduation of a glass measure is effected most accurately by placing it upon a perfectly level surface and then pouring into it the proper weight of distilled water at the temperature of 15.6 C. (60° F.); the fluidounce, weighing 455.7 grains, is preferably taken as the basis. A sufficiently accurate and more ready method is to measure into the graduate from a standard burette or pipette 30 C.c. of water for a fluidounce (29.57 C.c. is the exact equivalent). The extension of the graduating mark into a circle which passes entirely around the graduate is an improvement which obviates the necessity of placing the graduate upon a level place, as the corresponding mark upon the opposite side may be seen through the glass, and the graduate easily levelled even when held in the hand. For measuring smaller quantities of liquids graduated glass tubes of much less diameter should be used, and minim pipettes are more accurate, cleanly, and convenient than the conical minim graduates which are often used, and which possess several radical faults. By referring to Fig. 34 it will be seen that the graduations on the minim measure are necessarily in the narrowest and lowest portion of a comparatively tall measure: now, if it is desired to measure ten minims of a volatile oil, to add to a pill mass, the surface which the oil must traverse when this measure is inverted over the mortar is so great that probably 20 per cent. of the oil will be left adhering to the measure. In those instances of liquid preparations where the smaller liquid is miscible with the larger quantity of diluting liquid, the minim graduate may be rinsed and this loss recovered, but inconveniences are largely overcome and greater accuracy secured by the use of the minim pipette suggested by Dr. E. R. Squibb (see Fig. 35). This in its simplest form consists of a glass tube of small calibre, with its lower extremity somewhat contracted, and having minim graduations upon its side. The pipette is used by dipping the contracted end into the liquid to be measured, and upon applying suction by the mouth at the opposite end the liquid is drawn into the pipette; the moistened tip of the right forefinger is now tightly applied to the upper end of the tube to regulate the flow of the liquid, and a sufficient quantity is allowed to flow out by slightly raising the finger until the height of the liquid corresponds to the measure desired; pressure with the forefinger at once stops the flow, and the accurately measured quantity can be transferred to the bottle, mortar, or graduate by raising the finger and allowing the liquid to flow out. These pipettes may be had of four different capacities, holding 15, 20, 30, and 60 minims, and a reference to the cut will show that a sufficient length of tube above the graduations is left to secure the operator from any risk of getting a poisonous liquid into the mouth, except through extraordinary carelessness. One of the best methods of keeping the pipette ready for use is to have it pass

FIG. 34.

Minim measure.

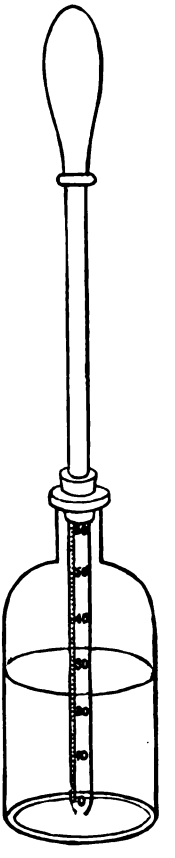
through a perforated cork which fits into a half-pint bottle containing alcohol or water (see Fig. 36), the liquid being renewed when it ceases to be clean. A rubber unperforated tube-nipple, inserted on the top of the pipette, has also been suggested to obviate the necessity of using suction with the mouth; it is used by first pushing it down over the top of the pipette until it will go no farther, then compressing the bulb and inserting the tip of the pipette into the fluid, when upon gradually relieving the pressure on the bulb the pipette commences to fill, and if not filled to the mark desired the bulb is pushed upward gently until the end is attained. In the use of tubes or glass measures of small diameter, it will be noticed that two distinct lines are visible on the surface of the liquid. This is due to the capillary attraction of the glass, which causes the edge of the liquid to creep up the sides, and the surface becomes concave and a *meniscus* is formed; the lowest point of the lower zone is usually selected by analytical chemists as the reading point, but it is manifest that a line drawn between the upper and lower zones slightly below the middle would give the most correct reading. Fortunately, the occasions are very rare in pharmaceutical operations where a difference in the method of reading need cause concern.

FIG. 35.



Minim pipette.

FIG. 36.



Minim pipette with bottle.

In administering small quantities of liquids the very convenient *drop* is almost always used. The impression that a drop is equivalent to a minim, and that sixty drops of any fluid are equivalent to a fluidrachm, is wide-spread. This impression doubtless arose from the fact that sixty ordinary drops of *water* are about equal to a fluidrachm; but many circumstances cause variations in the relative size of drops. Thick viscous liquids, like the mucilages and the syrups, necessarily produce large drops, because the drop adheres to the surface of the glass so long as its weight does not overcome its power of adhesion, whilst bromine and chloroform, heavy, mobile liquids, having very little adhesion to the dropping surface, produce very small drops, only one-fifth the size of the drop of syrup of acacia. The shape and surface of the vessel from which the liquid is dropped also have an influence in determining the size of the drop: the greater the extent of surface for the drop to adhere to, the larger, proportionally, will be the drop. In order that this subject should have an investigation of a rather wide range, the late Stephen L. Talbot, at the author's suggestion, constructed, after many laborious trials, the following table:

Table exhibiting the Number of Drops in a Fluidrachm of different Liquids, with the Weight in Grains and in Grammes.

Name.	Drops in ʒj. (60 m.)	Weight of ʒj		Name.	Drops in ʒj. (60 m.)	Weight of ʒj	
		in gr.	in Gm.			in gr.	in Gm.
Acetum Opii	90	61	3.95	Liquor Hydrarg. Nit.	131	123	7.97
Acetum Sanguinariæ	78	55½	3.59	Liquor Iodi Comp.	63	59	3.82
Acetum Scillæ	68	57	3.69	Liquor Plumbi Subacet.	74	70	4.53
Acid. Aceticum	108	58	3.75	Liquor Potassæ	62	58	3.75
Acid. Aceticum Dilut.	68	55	3.56	Liquor Potassii Arsen.	57	55	3.56
Acid. Carbolicum	111	59	3.82	Liquor Sodæ Chloratæ	63	62	4.01
Acid. Hydrochloricum	70	65	4.21	Liquor Zinci Chloridi	89	88	5.70
Acid. Hydrochlor. Dilut.	60	56	3.62	Oleores. Aspidii	130	52	3.36
Acid. Hydrocyanicum	60	54	3.49	Oleores. Capsici	120	51	3.30
Acid. Lacticum	111	66	4.27	Oleores. Cubebæ	123	52	3.36
Acid. Nitricum	102	77	4.98	Oleum Æthereum	125	50	3.24
Acid. Nitricum Dilut.	60	58	3.62	Oleum Amygd. Amaræ	115	55	3.56
Acid. Nitrohydrochlor.	76	66	4.27	Oleum Amygd. Expres.	108	48½	3.14
Acid. Phosphoric. Dilut.	59	57	3.69	Oleum Anisi	119	54	3.49
Acid. Sulphuricum	128	101	6.54	Oleum Bergamii	130	46	2.98
Acid. Sulphur. Aromat.	146	53	3.43	Oleum Cari	132	50	3.24
Acid. Sulphuric. Dilut.	60	58½	3.79	Oleum Caryophylli	130	57	3.69
Acid. Sulphurosum	59	55	3.56	Oleum Cinnamomi	126	53½	3.46
Æther Fortior	176	39	2.52	Oleum Copaibæ	123	49½	3.20
Alcohol	146	44	2.85	Oleum Cubebæ	125	51	3.30
Alcohol Dilutum	137	49	3.17	Oleum Fœniculi	125	53	3.43
Aqua	60	55	3.56	Oleum Gaultheriæ	125	62	4.01
Aqua Ammoniæ Fortior	66	50	3.24	Oleum Juniperi	148	49	3.17
Aqua Destillata	60	53½	3.46	Oleum Lavandulæ	138	52	3.36
Balsam. Peruvianum	101	60	3.88	Oleum Limonis	129	47	3.04
Bromum	250	165	10.69	Oleum Menthæ Piperitæ	129	50	3.24
Chloroform. Purificatum	250	80	5.18	Oleum Ricini	77	51½	3.33
Copaiba	110	51	3.30	Oleum Rosæ	132	47	3.04
Creasotum	122	56½	3.66	Oleum Rosmarini	143	50	3.24
Ext. Belladon. Fluid.	156	57	3.69	Oleum Sassafras	133	58	3.75
Ext. Buchu Fluidum	150	47½	3.07	Oleum Terebinthinæ	136	45½	2.94
Ext. Cimicifugæ Fluid.	147	48	3.11	Oleum Tiglii	104	50	3.24
Ext. Cinchonæ Fluid.	138	58	3.75	Spiritus Æther. Comp.	148	45	2.91
Ext. Colchici Rad. Fl.	160	57	3.69	Spiritus Æther. Nitrosi	146	47	3.04
Ext. Colch. Sem. Fluid.	158	55	3.56	Spiritus Ammon. Arom.	142	48	3.11
Ext. Conii Fruct. Fluid.	137	61	3.95	Spiritus Camphoræ	143	47	3.04
Ext. Digitalis Fluid.	134	62	4.01	Spiritus Chloroformi	150	48	3.11
Ext. Ergotæ Fluidum	133	60	3.88	Spiritus Menthæ Pip.	142	47	3.04
Ext. Gelsemii Fluid.	149	49	3.14	Syrupus	65	72	4.66
Ext. Glycyrrhizæ Fl.	133	61	3.95	Syrupus Acaciæ	44	73	4.73
Ext. Hyoscyami Fluid.	160	59	3.82	Syrupus Ferri Iodidi	65	77	4.98
Ext. Ipecac. Fluidum	120	60	3.88	Syrupus Scillæ	75	74	4.79
Ext. Pareiræ Fluidum	140	57	3.72	Syrupus Scillæ Comp.	102	70	4.53
Ext. Rhei Fluidum	158	61	3.95	Syrupus Senegæ	106	70	4.53
Ext. Sarsap. Comp. Fl.	134	60	3.88	Tinctura Aconiti	146	46	2.98
Ext. Senegæ Fluidum	137	62	4.01	Tinctura Belladonnæ	137	53	3.43
Ext. Serpentariæ Fl.	148	47	3.07	Tinct. Benzoini Comp.	148	48	3.11
Ext. Uvæ Ursi Fluid.	137	60	3.88	Tinctura Cantharidis	131	51	3.33
Ext. Valerianæ Fluid.	150	49	3.17	Tinct. Cinchon. Comp.	140	49	3.17
Ext. Verat. Virid. Fl.	150	50	3.24	Tinctura Digitalis	128	53	3.43
Ext. Zingiberis Fluid.	142	48	3.11	Tinctura Ferri Chlorid.	150	53	3.43
Glycerinum	67	68	4.40	Tinctura Iodi	148	47	3.04
Hydrargyrum	150	760	49.24	Tinctura Nucis Vom.	140	44	2.85
Liquor Ammonii Acet.	75	56	3.62	Tinctura Opii	130	53	3.43
Liquor Acid. Arseniosi.	57	55	3.56	Tinctura Opii Camph.	130	52	3.36
Liquor Arsenici et Hydrargyri Iodidi	58	55	3.56	Tinctura Opii Deodor.	110	54	3.49
Liquor Ferri Chloridi	71	72	4.66	Tinctura Valerianæ	130	52	3.36
Liquor Ferri Citratis	71	72	4.66	Tinctura Verat. Virid.	145	46	2.98
Liquor Ferri Nitratis	59	59	3.82	Tinctura Zingiberis	144	46	2.98
Liquor Ferri Subsulph.	73	83	5.37	Vin. Colchici Radicis	107	55	3.56
Liquor Ferri Tersulph.	83	72	4.66	Vin. Colchici Seminis	111	54	3.49
				Vin. Opii	100	55	3.56

SPECIFIC GRAVITY.

A knowledge of the subject of specific gravity is necessary to the pharmacist, to enable him to identify substances or to judge of their purity, whilst the physician frequently depends upon it as an aid in diagnosing certain diseases. The definition which has proved most useful in the author's experience in teaching, is thus expressed: *Specific gravity is the relative weight of equal bulks of different bodies.* In ascertaining the ordinary weight of a body it is simply compared with an arbitrary standard selected by governmental authority, whilst in determining specific gravity, the body, if solid or liquid, is compared with a standard which is universal,—*i.e.*, an equal bulk of pure water expressed as 1[1] and taken at a given temperature and atmospheric pressure. In all the methods hereafter detailed, it must be borne in mind that the main object sought for *is the weight of a bulk or volume of water equal to that of the body that we wish to take the specific gravity of.* Archimedes proved experimentally that *a body immersed in a liquid lost as much weight as its own bulk of that liquid weighed:* hence is derived the general rule for taking specific gravity,—

RULE.—**Divide the weight of the body by its loss of weight in water, the quotient will be the specific gravity.**

The taking of the specific gravity of solids will be considered in the following order:

1. Solids insoluble in, but heavier than water.
2. Solids soluble in, but heavier than water.
3. Solids insoluble in, but lighter than water.
4. Solids soluble in, but lighter than water.

1. To take the specific gravity of a solid insoluble in, but heavier than water.

a. With the Balance.—It is customary to recommend a special balance for taking the specific gravity of solids, known technically as the hydrostatic balance; but a good prescription or analytical balance will answer perfectly for practical purposes. The substance, preferably in one piece, is first weighed accurately and the weight noted; a horse-hair is then tied around it with a slip-knot, and a tight loop at the other end is made, which is attached to the hook at the end of the scale-beam; a small wooden bench made for the purpose, or extemporized by taking out the bottom and one of the sides of a small wooden or stiff pasteboard box, is now arranged over the scale-pan so that it does not touch it or interfere with its free movement; upon this a small beaker or wide-mouthed jar is placed, and two-thirds filled with pure water (see Fig. 37). The horse-hair must be adjusted to such length that it will permit of the complete immersion of the substance in the water. Upon weighing the immersed substance, after freeing it from attached air-bubbles, it will be at once noticed that it has lost weight, and all that

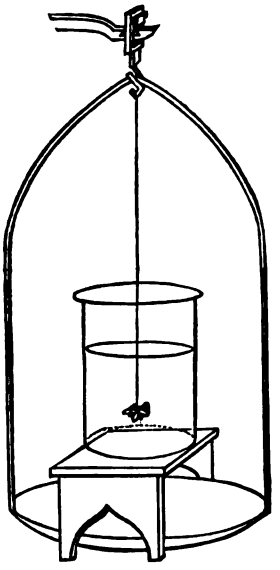
[1] The temperature usually specified in the U. S. Pharmacopœia, 1880, is 15.6° C. (60° F.); when not specified, it is intended to mean 15° C. (59° F.); but in many investigations, particularly those conducted in Europe, the temperature selected is that of the maximum density of water, 4° C. (39.2° F.). For practical purposes the temperature of 25° C. (77° F.) is most useful in the latitude of the United States, but it is rarely used.

remains to be done is to apply the rule, divide the weight of the body by its loss of weight in water.

For example, 805.5 grains of copper lose by immersion in water 90 grains; then 805.5 divided by 90 gives 8.95, the specific gravity of the copper. See also Nicholson's hydrometer, p. 73.

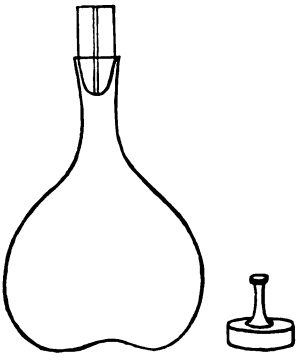
b. With the Specific Gravity Bottle.—This instrument in its most usual form is a bottle having an elongated, narrow neck, fitted with a ground-glass stopper, and holding, when filled, exactly 1000 grains of pure water at a given temperature (see Fig. 38). The reason for selecting 1000 grains for the contents is to avoid the necessity of making a calculation to obtain the specific gravity of a liquid.[1] To use the instrument for a solid

FIG. 37.



Taking the specific gravity of a solid.

FIG. 38.



1000-grain bottle.

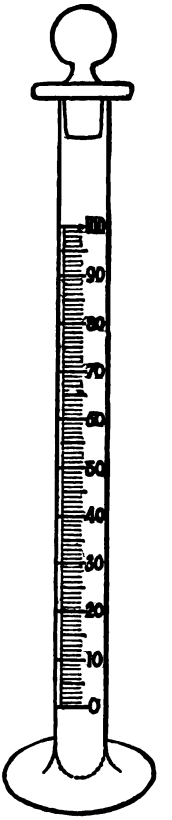
substance, the previously-weighed body is dropped into the bottle, which is then filled with water at the temperature of 15.6° C. (60° F.), the bottle carefully dried, and, after the counterpoise (the exact weight of the empty bottle) has been placed upon the opposite scale-pan, it is weighed. To obtain the *loss of weight* in water of the substance, it is only necessary to deduct the weight of the contents of the bottle (*i.e.*, that of the water and the immersed body) from the weight of the body in air, plus that of the water which the bottle holds when full,—*i.e.*, 1000 grains; the rule is then to be applied, divide the weight of the body by its loss of weight in water.

Example.—A piece of aluminium wire weighs 100 grains; when dropped into a 1000-grain bottle, and the bottle filled with water at the proper temperature, the weight of both is 1062 grains. As the bottle when filled with water alone held 1000 grains, and as the weight of the aluminium in air is 100 grains, both together weigh 1100 grains; hence 1100 grains, less 1062 grains, gives 38 grains, the loss of weight of the

[1] See specific gravity of liquids, p. 66.

aluminium in water. *Apply the rule*, $\frac{100}{38} = 2.63$, sp. gr. The specific gravity of any insoluble powder, like calomel, litharge, etc., may be taken in exactly the same way, but care must be observed to agitate the powder with a small quantity of water in the bottle, before adding the rest, to cause the bubbles of air to escape.

FIG. 39.



Graduated specific-gravity tube.

c. *With the Graduated Tube.*—A graduated tube is provided in which each space indicates a grain or a gramme (C.c.) of water (or better if graduated in smaller subdivisions); the zero mark should be somewhat above the bottom of the tube, as shown in Fig. 39. Now, if water be poured into the tube exactly up to the zero mark, and a weighed solid body dropped into it, the water will rise in the tube and indicate the weight of a bulk of water equal to that of the substance; this is equivalent to the loss in water: *then apply the rule*, divide the weight of the body by its loss of weight in water. It is evident that this method cannot be as accurate as either of those above mentioned, as small differences are more clearly indicated by a good balance than by tube-reading.

d. By immersing the solid in a transparent liquid of the same density.—This method may be applied where the body is small, is not very heavy specifically, and is insoluble in the liquid. A heavy liquid is chosen, like solution of mercuric nitrate; the solid is found to float on the surface of the liquid, and water is added until the solid neither rises nor sinks, but swims indifferently: the specific gravity of the solid will of course be that of the liquid, which may be ascertained by the specific-gravity bottle (see page 66).

2. To take the specific gravity of a solid soluble in, but heavier than water.

A liquid must be selected in which the solid is insoluble, like olive oil, almond oil, benzin, or oil of turpentine: the specific gravity of the oil having been ascertained, it is used just as if it were water, the object being to find out the loss of weight that the substance suffers when immersed in the oil; this having been obtained, a simple proportion must be made, as follows: as the specific gravity of the oil is to the specific gravity of water, so is the loss of weight in the oil to the loss of weight in water: *then apply the rule*, divide the weight of the body by its loss of weight in water.

Example.—200 grains of citric acid lose by immersion in oil 115 grains; then, as

Sp. gr. of oil.		Sp. gr. of water.		Loss of weight in oil.		Loss of weight in water.	
.920	:	1.000	::	115	:	125	$\frac{200}{125} = 1.6$, sp. gr. of citric acid.

It is obvious that either the balance, specific-gravity bottle, or gradu-

ated tube can be used in this case; but it is possible in some cases to coat the soluble substance with varnish and treat it then as an insoluble substance, and thus avoid the use of an oily liquid. A pill of blue-mass may be coated with shellac varnish, and then treated as an insoluble substance as in 1, *b*. The practical difficulty, however, is to secure a thin coating which shall be impervious to water.

3. To take the specific gravity of a solid insoluble in, but lighter than water.

The solution of this problem requires the aid of a heavy insoluble body, which is to be attached to the light body, so as to secure the immersion of both: it is plain that if the loss of weight in water of the heavy substance is deducted from the loss of weight in water of both the heavy and the light body, the result must give the loss of weight in water of the light body alone: then *the rule must be applied*, divide the weight of the body by its loss of weight in water.

Example.—A piece of paraffin weighs 174 grains, a piece of brass loses by immersion in water 6 grains; when the brass is attached to the paraffin, both together lose by immersion in water 206 grains; by deducting 6 grains (the loss in water of the brass) from 206 grains (the loss in water of both) the loss in water of the paraffin alone is found,—*i.e.*, 200 grains; then $\frac{174}{200}=0.870$, sp. gr. of paraffin. See also Nicholson's hydrometer, p. 73.

4. To take the specific gravity of a solid soluble in, but lighter than water.

The use of the specific-gravity bottle is recommended in cases of this kind, and the process is the same as in 2: the selection of a suitable liquid lighter than the body, and in which it is insoluble, is, however, usually attended with difficulty. The proportion would be, as the specific gravity of the light liquid is to the specific gravity of water, so is the loss of weight in the light liquid to the loss of weight in water. *Then the rule must be applied*, divide the weight of the body by the loss of weight in water.

SPECIFIC GRAVITY OF LIQUIDS.

The specific-gravity bottle is the most accurate instrument that has yet been devised for taking the specific gravity of liquids. Fig. 40 shows an improved form: it is used as follows. The liquid to be tested is first brought to the proper temperature, 4° C. (39.2° F.), 15.6° C. (60° F.), or 15° C. (59° F.), according to the standard selected for the bottle; the bottle is filled with the liquid to the mark on the neck, dried carefully, and weighed accurately, using the counterpoise on the opposite pan. If the 1000-grain or 100-gramme bottle has been used, the weight of the liquid at once indicates the specific gravity: thus, the bottles would hold 1160 grains, or 116 grammes, of hydrochloric acid, 1250 grains, or 125 grammes, of glycerin, 750 grains, or 75 grammes, of ether, and 13,500 grains, or 1350 grammes, of mercury, and the specific gravity of each would be respectively 1.160, 1.250, 0.750, and 13.5, thus directly showing the relation to the specific gravity of water, 1. To

show the use of an ordinary prescription-vial in this process, one containing about a fluidounce may be taken; if it holds 455.7 grains of pure water to a mark upon the neck it will be convenient, because it will at the same time give the weight of a fluidounce of the liquid. It is evident that a bottle holding any moderate quantity may be used in the same way.

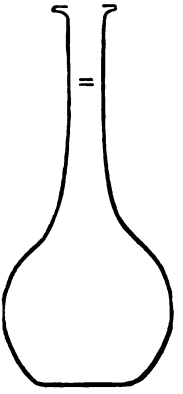
FIG. 40.

Metric specific-gravity bottle (Squibb).

A fluidounce bottle would hold 528.6 grains of hydrochloric acid, 569.6 grains of glycerin, 341.7 grains of ether, and 6151.9 grains of mercury, and the specific gravity would be obtained by the following proportion:

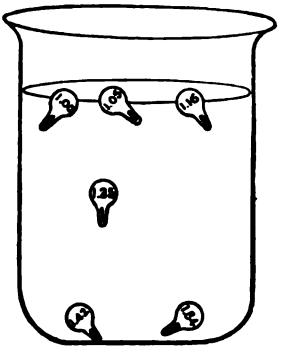
Example.—As 455.7, the number of grains of pure water that the bottle holds, is to 1.000, the

FIG. 41.



Specific-gravity bottle.

FIG. 42.



Lovi's beads.

specific gravity of water, so is 528.6, the number of grains of hydrochloric acid that it holds, to 1.160, the specific gravity of hydrochloric acid. 455.7 : 1.000 :: 528.6 : 1.160.

In practice, it is simply necessary to divide the number of grains of liquid that the bottle holds by 455.7 and adjust the decimal point, or multiply the weight of the liquid by 2.1945, the modulus of the bottle. The accuracy of these bottles depends entirely upon the care with which they are made and used, and it is better to scratch, with a file, two marks upon the neck of a long-necked flask, one showing the upper edge of the meniscus and the other marking the lowest point (see Fig. 41). In filling, it is a good practice, after bringing the liquid to the proper temperature, to exceed slightly the quantity indicated by the mark on the neck, and then to make a small roll of filtering-paper and neatly absorb the excess by inserting the roll in the neck so that it shall just touch the surface. The more expensive specific-gravity bottles have an accurately-fitted stopper made of thermometer-tube, and hold exactly 100 grammes, or 1000 grains, when the bottle, including the capillary tube of the stopper, is entirely full (see Fig. 38). They are not so con-

venient as a correctly-marked, narrow-necked bottle (see Figs. 40 and 41), nor are they practically more accurate. They have to be filled to the brim and the stopper then inserted; this causes an overflow, and the necessary wiping and the natural warmth of the hands usually expand the liquid by raising the temperature, and prevent accurate results.

Lovi's beads, or *specific-gravity beads*, are sometimes used for taking the specific gravity of liquids; they are especially useful in cases where a boiling liquid is to be evaporated until it has a given specific gravity, and in mixing liquids of different densities. They are balloon-shaped, hollow globes of glass, of different sizes and weights, having specific-gravity figures scratched upon their sides: these figures indicate the specific gravity of a liquid in which the beads swim indifferently; they neither rise nor sink, when not disturbed at the given temperature, if the specific gravities of the bead and liquid are the same. The illustration, Fig. 42, shows their method of use; those heavier than the liquid sinking, those lighter floating, whilst the one supported indifferently (1.25) indicates the specific gravity of the liquid. Lovi's beads may be defined as hydrometers which indicate but one specific gravity.

HYDROMETERS.

Hydrometers, sometimes called *areometers*, are floating instruments which are used to indicate the specific gravities of liquids by sinking to a depth corresponding to the densities of the liquids. Their principle of action was probably first made known by Archimedes, and depends upon the fact that when a solid body is placed in a liquid in which it is capable of floating, it sinks to a certain point, and this floating-point is reached when the body has displaced a volume of liquid exactly equal to its own weight. Thus, if a hydrometer has a specific gravity exactly three-fourths that of water, it will sink in water until exactly three-fourths of its volume is immersed; the same hydrometer would swim indifferently, like a Lovi's bead, in ether having the specific gravity of 0.750, for the obvious reason that the specific gravities of the solid and liquid are identical. Hydrometers may be divided into two classes for convenience of study: 1. Those in which the weight is constant, but the depth of immersion subject to change. 2. Those in which the depth of immersion is constant, but the weight subject to change. To the first class belong nearly all the hydrometers specially useful to pharmacists, and of these, two kinds are generally used, one for liquids heavier than water, the other for those lighter. They are known as Baumé's, Cartier's, Gay-Lussac's, Zanetti's, Twaddell's, but the best of all is the specific-gravity scale hydrometer. To the second class belong the hydrometers which are intended to sink, by the addition of weights, to a given mark on the stem, and thus displace a constant volume, like Fahrenheit's, Nicholson's, Guyton de Morveau's, etc.

1. Hydrometers in which the weight is constant, but the depth of immersion subject to change.

Baumé's Hydrometers.—This form is treated first in detail because it was the first one of its class to come into general use, having been originally described by Baumé in his "Elémens de Pharmacie." Two

instruments were used by Baumé, one termed *Pèse-Acide* or *Pèse-Sirop*, for liquids heavier than water, the other *Pèse-Esprit*, for liquids lighter than water. This hydrometer, as now made, consists of a glass tube loaded at the bottom with mercury or small shot, having a bulb blown in it just above the loaded end. A simple cylindrical tube (see Fig. 43), loaded so as to cause it to assume an upright position in a liquid, may be used as a hydrometer: the only advantage gained in expanding the lower portion into bulbs is one of convenience, that of increasing the volume of the hydrometer and thus permitting the use of shorter instruments. The graduations upon the stem of Baumé's hydrometer are entirely arbitrary, and were made in the following manner:

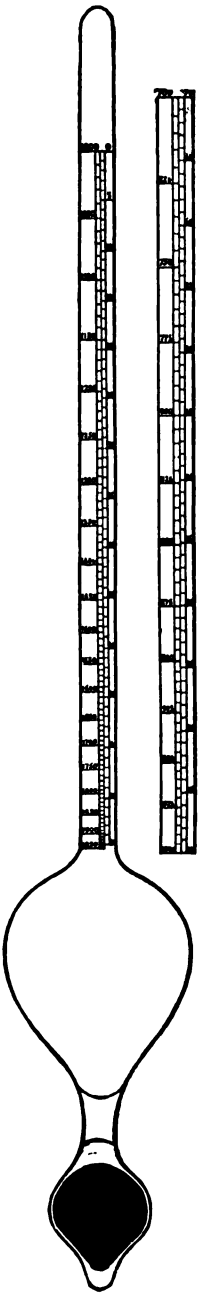
FIG. 43.

Cylindrical hydrometer.

For the hydrometer to be used for *liquids heavier than water*, sufficient mercury was added to the lower bulb to cause it to sink in water to a convenient point near the top of the stem: this was marked 0. The instrument was then placed in a solution containing fifteen per cent. by weight of common salt, and the point at which it rested was marked 15: the space between these two points was divided into fifteen *equal* parts, and the scale below was extended by marking off similar spaces. *For liquids lighter than water*, the instrument was placed in a ten-per-cent. by weight solution of common salt, and loaded so that it floated at a point just above the bulb: this was marked 0. The hydrometer was then transferred to water, the point at which it rested was marked 10, the space between was divided into ten equal parts, and the scale above was extended by marking off similar spaces. The illustration, Fig. 44, was drawn from two of Pile's hydrometers, and shows the manner of graduating the Baumé scale for both hydrometers, and, in addition, the corresponding specific-gravity figures. The Baumé hydrometer is rapidly going out of use, being replaced by a hydrometer having a graduated scale, in which the graduations represent the specific gravities.

The specific-gravity scale hydrometer, which should be used exclusively, is more

FIG. 44.



Hydrometer, double scale.

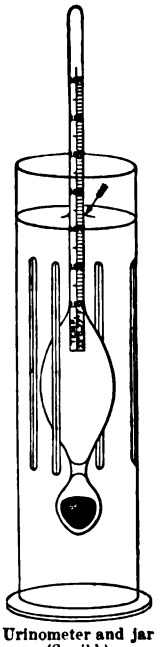
convenient and useful to the pharmacist. The graduations upon the stem are not arbitrarily chosen, but indicate at once the specific gravity of a liquid when floated in it. Two hydrometers are necessary, one for liquids heavier than water, and one for liquids lighter than water; for special purposes it is often desirable to have five or six hydrometers, beginning with one for very light liquids and ending with one for very heavy liquids, and if the diameter of the stem is narrow the divisions in the scale are not so close together, and thus a more accurate reading of the graduations is possible and the delicacy of the hydrometer increased. It must be borne in mind, however, that the hydrometer cannot be as accurate an instrument for taking specific gravity as the specific-gravity bottle: the adhesion of air-bubbles when in use, the liability to variation in the diameter of the stem, the inaccuracies in the scale and the difficulties of adjusting it so as to give correct readings, and the want of uniformity among the makers in fixing the reading-point, render it necessary for the pharmacist to verify each instrument and note its error before accepting it for practical use. In selecting a hydrometer with a specific-gravity scale, it should be at once noticed whether the graduated spaces are equal: if they are, it is useless to attempt to verify it, as it cannot be accurate, for the degree of the immersion varies with the specific gravity of the liquid, and "equal differences of specific gravity cannot be indicated by equal spaces on the scale, but by the differences of the reciprocals of those specific gravities, or by proportionate quantities." In the hydrometers shown in Fig. 44, the arbitrary scale of Baumé, made up of equal spaces, is shown immediately in contact with a specific-gravity scale: the spaces of the latter gradually increase in size from below upward, and the highest space is nearly four times the size of the lowest. The method of graduating this scale differs with different makers, but by the use of Clarke and Ackland's process it is possible to make a scale without using any other liquid than water if a correct table of reciprocals is employed (see Watts's Dictionary, vol. iii. p. 207). Before any hydrometer is accepted for use, it should be tested by floating it in water at the temperature indicated on the hydrometer, and, the specific gravity of several liquids having been ascertained carefully by the specific-gravity bottle, the hydrometer should be floated in the same liquids, and any deviation carefully noted. A hydrometer which registers uniformly one or two points too low or too high need not be rejected, because the error can be added or subtracted each time and the constant error marked on the box for a memorandum; but if an error of any magnitude has to be added to one part of the scale, and another subtracted from another part, it is economy to reject the instrument at once. Hydrometers are usually floated in tall, cylindrical glass jars (see Fig. 45), and it is frequently necessary to cool the liquid by placing the jar in ice-water after inserting a thermometer, and, after the temperature has been lowered to the desired point, observing the point to which the hydrometer sinks in the liquid. It is to be regretted that there is no fixed rule for a

FIG. 45.

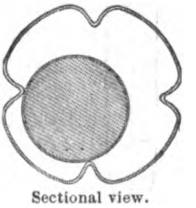
Hydrometer jar.

reading-point; some makers adjust their instruments so as to read from a reflection in the upper part of the meniscus, others (probably the majority) prefer to take the exact level of the liquid, disregarding the meniscus altogether; this may be easily done in all cases where the liquid is transparent, or nearly so, by holding the jar containing the hydrometer at first exactly on a level with the eye, and then glancing slightly below, when a line can be traced which will exactly join the divided surface of the liquid upon either side of the stem: in case of opaque liquids an allowance can be made for the meniscus. The pharmacist should choose one or the other method and adhere to his choice, so that his verification of his own hydrometer may not vary (see Fig. 46, in which the arrow shows the point to read). It is usually best to cool the liquid below the standard temperature adopted for the hydrometer, and then, after wiping the jar, the correct higher temperature may be gradually obtained by grasping the jar with the hands and passing them up and down to warm the liquid. A hydrometer having an elongated bulb with cylindrical sides, as shown in Fig. 47, is more likely to give a false indication if permitted to touch the sides of the jar than one having an oval or globular bulb (see Fig. 46); the latter can touch the jar at only one point, and hence can move freely up and down, whilst the former may have one side touching the side of the jar for its entire length. To obviate this, Dr. Squibb suggests the use of a jar with four perpendicular indentations in it, and a hydrometer having an oval bulb (see Fig. 46). The points of contact between the urinometer bulb and the indentations in the jar are best shown in the transverse sectional view immediately below the cut of the urinometer.

FIG. 46.



Urinometer and jar (Squibb).



Sectional view.

The *urinometer* is one of the most useful special applications of the hydrometer; as its name indicates, it is used to take the specific gravity of urine; a special scale, which is easily understood, is sometimes used. The very delicate stem, which hardly permits of the use of specific-gravity figures, is divided into sixty spaces, numbered from 0 to 60; by adding 1000 to each of these numbers, and pointing off three decimal places from the right, the true specific gravity is shown. In Dr. Squibb's urinometer the specific gravity is indicated without abbreviation, the number highest on the scale being 1.000, the lowest 1.060, the intervening figures being 1.010, 1.020, 1.030, 1.040, and 1.050.

The specific gravity of urine from healthy subjects ranges from 1.010 to 1.020; that from diabetic patients has a specific gravity varying from 1.030 to 1.060.

The *saccharometer* is intended to take the specific gravity of syrups. The scale is sometimes graduated so as to indicate the percentage of sugar in solution, rarely the actual specific gravity: usually Baumé's scale

(*pèse-sirop*) is used. The *elæometer*, a very delicate instrument, is used to take the specific gravity of fixed oil. The *lactometer* is employed in detecting the adulteration of milk with water: it has a limited range, and the scale usually shows the points at which it floats in milk mixed with different proportions of water. Hydrometers are often made for taking the specific gravity of liquids, like benzin, ether, petroleum, vinegar, wine, beer, solutions of silver nitrate, sea-water, etc.; probably the most useful to the pharmacist of all of those having special applications is the one made for testing alcohol.

FIG. 47.

Alcoholmeter.

Alcoholmeters may be purchased which combine the thermometer with the hydrometer, as shown in Fig. 47, and the scale frequently has the percentage by volume of absolute alcohol marked opposite the corresponding specific gravity; when graduated so as to show the percentage by weight, they are more useful, however, on account of the adoption of the principle of parts by weight in the U. S. Pharmacopœia of 1880, thus obviating the necessity of using an alcoholmetrical table or making a calculation.

Tralles's hydrometer is an alcoholmeter having a centesimal scale: it is used by the United States government in gauging spirits, and is in general use by distillers and others. Each division of the scale corresponds to a given percentage of pure alcohol by volume in the liquor. In the United States Dispensatory, 15th Edition, p. 1817, a table is given showing the value of Tralles's degrees in specific gravity and Baumé's degrees.

Cartier's hydrometer, largely used in France, is merely a modification of Baumé's *pèse-esprit*, or hydrometer for liquids lighter than water; the zero of the scale is the same as Baumé's (10°), but the degrees are not of the same value, 32° of Baumé's scale being equal to 30° Cartier. Dorvault gives the following approximate rule for conversion: Cartier's degrees may be converted into Baumé's by subtracting 10, multiplying the remainder by .08, and adding the product to Cartier's degree.

Baumé's degrees may be converted into Cartier's by subtracting 10, multiplying the remainder by .08, and subtracting the product from Baumé's degree.

Gay-Lussac's centesimal alcoholmeter has a scale divided into 100 unequal degrees: the zero corresponds to pure water at 15° C. (59° F.) and 100° to absolute alcohol. The advantage of this method is that every intermediate degree expresses the percentage of pure alcohol by measure contained in the spirit: thus, when the instrument stands at 50° in an alcoholic liquid, it indicates that 100 measures of the liquid contain 50 of pure alcohol.

Sikes's hydrometer is used in Great Britain in the collection of the excise revenue: it is a brass instrument having a spherical bulb, with a weight at the bottom to make it float upright; the stem is divided

into twenty parts, and every other division numbered, from 0 to 10. A series of nine weights are furnished with the instrument, numbered from 10 to 90; these are to be added to the weight at the bottom to cause the hydrometer to sink, so that a reading may be had on the graduated scale; this reading added to the number on the weight employed, gives a figure which indicates the strength of the spirit by referring to a table which accompanies the instrument.

Jones's hydrometer is similar to Sikes's, but by many is regarded as an improvement on it.

Dica's hydrometer belongs to the same class.

Twaddell's hydrometer is frequently employed in England, and technical works often quote the degrees of this scale. It is used for liquids heavier than water, and is graduated so that the number of the degree, multiplied by 5 and added to 1000, gives the specific gravity: thus, 20° Twaddell indicates the specific gravity of 1100 or 1.100; 50° Twaddell, 1250 or 1.250.

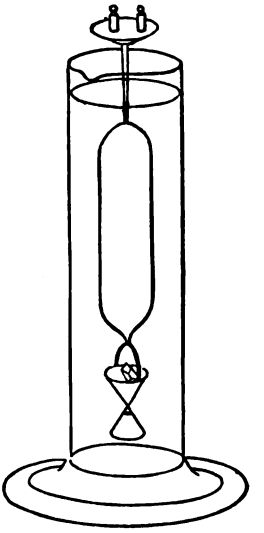
Beck's hydrometer is rarely used or referred to: in this scale 0 corresponds to the specific gravity 1.00, and 30 to that of 0.850; the scale is extended equally above and below 0. For tables, see Bayley's Chemist's Pocket-Book, p. 178.

Zanetti's hydrometers have a scale which requires the addition of a cipher to the number of the degree to show the specific gravity.

2. Hydrometers in which the depth of immersion is constant, but the weight subject to change.

Fahrenheit's hydrometer was one of the first instruments of this class to come into general use. Robert Boyle described, however, in 1675, his "New Essay Instrument," and Fahrenheit's hydrometer was very similar to it in principle; it had but a single mark on the stem, which was surmounted by a small scale-pan; weights were placed in the pan to cause the hydrometer to sink to the mark. Now, as this mark indicated the point at which the instrument would float in water at a given temperature when certain weights were placed on the pan, it follows that when it was immersed in a liquid of different specific gravity the weights would have to be changed to float the instrument to the fixed mark; the ratio which this weight bore to the weight used for water gave the specific gravity.

FIG. 48.



Nicholson's hydrometer.

Nicholson's hydrometer is similar in principle to Fahrenheit's, but is modified so that it can be used for taking the specific gravity of heavy or light solids. Fig. 48 is an illustration of one of the most convenient forms of the instrument; it is usually made of brass; there is a single mark on the stem and a scale-pan on the summit. To the lower extremity of the hydrometer two conical cups are attached; their apexes are joined so as to resemble an hour-glass; the lowest cone has several apertures at the top, to permit

of the escape of air when the instrument is immersed. The weight of the hydrometer is usually so adjusted that a 1000-grain weight is needed on the scale-pan to float it to the mark on the stem. Now, to take the specific gravity of a piece of zinc weighing less than 1000 grains, the 1000-grain weight is removed from the pan and the piece of zinc substituted for it, weights are added until the instrument floats at the mark on the stem, and it is found that an addition of 655 grains has been necessary: it is evident that the difference between 1000 and 655 gives the weight in air of the zinc, 345 grains. The zinc is now placed in the upper conical cup and weights are again placed upon the scale-pan, and it is found that the zinc has lost in weight 50 grains by immersion in water; the specific gravity is obtained by applying the well-known rule, divide the weight of the body by the loss of weight in water: $\frac{345}{50} = 6.9$, sp. gr. of zinc. The lower cup is used for taking the specific gravity of bodies lighter than water, and is very convenient, the weight of the hydrometer keeping the light body submerged when the lower cup is placed over it: the specific gravity is obtained in the same manner as in the case of bodies heavier than water. One of the advantages of Nicholson's hydrometer is that it can be used in place of a balance for weighing small quantities, as shown above.

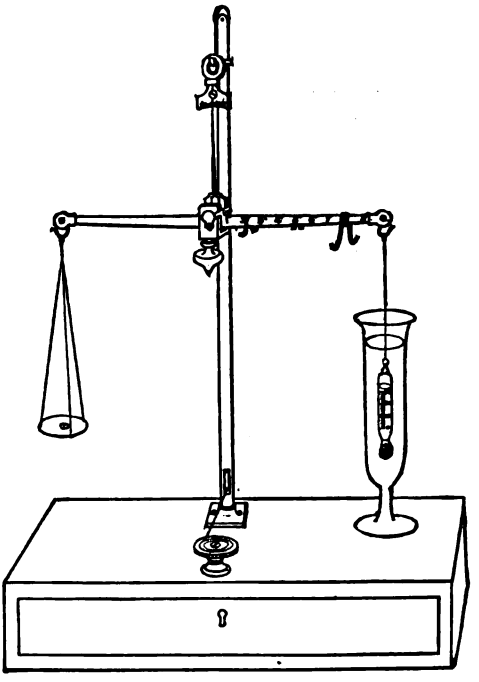
METHODS OF TAKING THE SPECIFIC GRAVITY OF SMALL QUANTITIES OF LIQUIDS.

Mohr's Apparatus.—The illustration of this apparatus (see Fig. 49) represents the improved form, yet it is quite possible for a pharmacist to construct one for himself that will answer practical purposes. It will be noticed that one end of the beam is divided into ten equal spaces, and a small glass thermometer is suspended from the extremity by a slender platinum wire, whilst the opposite scale-pan is so adjusted that it exactly counterbalances the thermometer. When the thermometer is immersed in pure water at 15° C. (59° F.), a brass wire weight is placed upon the hook at the end of the beam, and this restores the equilibrium. Now, it is apparent that if a lighter liquid, like alcohol at 15° C. (59° F.), is substituted for the water, the equilibrium cannot be maintained, and the thermometer will sink: the brass wire weight is then to be moved along the beam towards the central knife-edge until the balance is nearly restored, and this point will be found at 8, which gives the first decimal figure; still further to approach equilibrium, a wire weight, one-tenth the weight of the larger one, is pushed along the beam until it rests at the 2-mark, which gives the second decimal figure; whilst thoroughly to restore the balance the smallest weight (still one-tenth smaller) is placed at 5, and thus the third decimal figure is obtained, and the specific gravity of the alcohol is shown to be 0.825. Specific gravities of liquids heavier than water are obtained in the same way, except that the large brass-wire weight is left hanging on the hook at the end of the beam and additional weights are placed upon the beam until equilibrium is restored.

A prescription balance could be easily converted into a Mohr's appa-

ratus, and the thermometer replaced by a glass stopper suspended by a horse-hair. The thermometer in the improved form of apparatus merely serves to indicate the temperature and act as a convenient weight: in the home-made apparatus especial care must be exercised in adjusting the wire-hook weight so as exactly to immerse the stopper in water at the proper temperature.

FIG. 49.

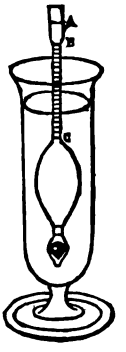


Mohr's specific-gravity apparatus.

Gannal's Method.—Gannal suggested a very convenient modification of this method of taking the specific gravity of a liquid. A piece of glass, "densimètre hydrostatique," having the shape of an olive, has a volume of 10 cubic centimetres. This is suspended from the hook at the end of the beam of a balance by a horse-hair (see Fig. 37), and weights are added to the opposite scale-pan until the balance is restored; it is then immersed in the liquid, and the metric weight required to restore the equilibrium gives the specific gravity without a calculation.

Specific-Gravity Pipette.—Grauer recommends the use of a small pipette having a fine orifice at the lower end, and at the upper end a short piece of rubber tube closed by a pinchcock; a mark is scratched on the pipette to show where a convenient weight of water rises to (1 C.c.); enough of the liquid to be tested is sucked through the tube to rise to the mark, it is then closed; the weight of the liquid indicates its specific gravity.

FIG. 50.



Rousseau's densimeter.

Rousseau's Densimeter.—This ingenious instrument is constructed upon the plan of a hydrometer (see Fig. 50). The stem from B to C is divided into 20 equal parts; the cup-shaped tube upon the summit of the stem holds exactly 1 cubic centimetre. When the densimeter is floated in water at the proper temperature, it sinks to the point C at the bottom of the stem; when the cup is filled with water to the cubic-centimetre mark, it causes the instrument to sink to the point B; this space, B C, being then divided into 20 equal parts, it follows that each division corresponds to $\frac{1}{20}$ of a gramme, or 0.05 Gm. If one cubic centimetre of oil of rose were placed in the cup, it would sink the densimeter to 17.2 divisions of the scale; then $17.2 \times 0.05 = 0.860$, sp. gr. of oil of rose.

Table giving the Specific Gravities of Officinal Substances arranged in the order of their densities.

Specific Gravity.	Officinal Name.	Weight of one Fluid-ounce in Grains.
0.670—0.675	Benzinum	305.3—307.59
0.725	Æther Fortior	330.3
0.750	Æther	341.7
0.810	Spiritus Ammoniæ	369.1
0.820	Alcohol	373.6
0.823—0.825	Spiritus Ætheris Nitrosi	375.0—375.9
0.834	Manna	
0.835—0.860	Petrolatum	
0.850	Oleum Erigerontis	387.3
0.850	Oleum Limonis	387.3
0.850—0.890	Oleum Aurantii Florum	387.3—405.5
0.855—0.870	Oleum Terebinthinæ	389.6—396.4
0.860	Oleum Aurantii Corticis	391.9
0.860	Oleum Rosæ	391.9
0.860—0.890	Oleum Bergamii	391.9—405.5
0.870	Oleum Coriandri	396.4
0.870	Oleum Juniperi	396.4
0.872—0.874	Amyl Nitris	397.3—398.2
0.880	Oleum Rutæ	401.0
0.880	Oleum Thymi	401.0
0.885	Spiritus Ammoniæ Aromaticus	403.2
0.889—0.897	Æther Aceticus	405.1—408.7
0.890	Oleum Copaibæ	405.5
0.890	Oleum Lavandulæ	405.5
0.890	Oleum Lavandulæ Florum	405.5
0.900	Aqua Ammoniæ Fortior	410.1
0.900	Oleum Eucalypti	410.1
0.900	Oleum Menthæ Piperitæ	410.1
0.900	Oleum Menthæ Viridis	410.1
0.900	Oleum Rosmarini	410.1
0.900—0.910	Acidum Oleicum[1]	410.1—414.6
0.900—0.920	Oleum Adipis	410.1—419.2
0.910	Oleum Ætherеum	414.6
0.910	Oleum Sabinæ	414.6
0.914—0.920	Oleum Amygdalæ Expressum	416.5—419.2
0.914—0.923	Oleum Sesami	416.5—420.6
0.915—0.918	Oleum Olivæ	416.9—418.3
0.917—0.930	Spiritus Frumenti	417.8—423.8
0.920	Oleum Cari	419.2
0.920	Oleum Cajuputi	419.2
0.920	Oleum Chenopodii	419.2
0.920	Oleum Cubebæ	419.2
0.920	Oleum Succini	419.2
0.920—0.925	Oleum Morrhuæ	419.2—421.5
0.920—0.930	Oleum Gossypii Seminis	419.2—423.8
0.925—0.941	Spiritus Vini Gallici	421.5—428.8

[1] The specific gravity of .800 — .810 given in U. S. Pharmacopœia is an error.

Table giving the Specific Gravities of Officinal Substances arranged in the order of their densities.—(*Continued.*)

Specific Gravity.	Officinal Name.	Weight of one Fluid-ounce in Grains.
0.928	Alcohol Dilutum	422.8
0.930	Oleum Myristicæ	423.8
0.936	Oleum Lini	426.5
0.938	Adeps	
0.940	Oleum Hedeomæ	428.3
0.940—0.955	Oleum Tiglii	428.3—435.1
0.940—0.998	Copaiba	428.3—452.5
0.945	Cetaceum	
0.945	Oleum Santali	430.6
0.950	Oleum Valerianæ	432.9
0.950	Tinctura Ferri Acetatis	432.9
0.950—0.970	Oleum Ricini	432.9—442.0
0.955	Acidum Sulphuricum Aromaticum	435.1
0.955—0.967	Cera Flava	
0.959	Aqua Ammoniæ	437.0
0.960	Oleum Fœniculi	437.4
0.965—0.975	Cera Alba	
0.970	Oleum Picis Liquidæ	442.0
0.976—0.990	Oleum Anisi	444.7—451.1
0.980	Tinctura Ferri Chloridi	446.5
0.989—1.010	Vinum Rubrum	450.6—460.2
0.990—0.995	Camphora	
0.990—1.010	Vinum Album	451.1—460.2
1	Aqua Destillata	455.7
1.0015	Liquor Calcis	456.3
1.0083	Acidum Aceticum Dilutum	459.4
1.017—1.021	Oleum Sinapis Volatile	463.4—465.2
1.018—1.028	Fel Bovis	
1.022	Liquor Ammonii Acetatis	465.7
1.022—1.023	Acidum Sulphurosum	465.7—466.1
1.028	Thymol (when solid)	
1.030	Limonis Succus	469.3
1.035—1.085	Creasotum	471.6—494.4
1.036	Liquor Potassæ	472.1
1.040	Oleum Cinnamomi	473.9
1.040	Oleum Myrciæ	473.9
1.040	Oleum Pimentæ	473.9
1.043—1.049	Oleum Amygdalæ Amaræ (H,CN removed)	475.2—478.0
1.044	Liquor Sodæ Chloratæ	475.7
1.048	Acidum Aceticum	477.5
1.049	Acidum Hydrochloricum Dilutum	478.0
1.050	Liquor Ferri Nitratis	478.4
1.050	Oleum Caryophylli	478.4
1.056—1.058	Acidum Aceticum Glaciale	481.2—482.1
1.057	Acidum Phosphoricum Dilutum	481.6
1.059	Acidum Nitricum Dilutum	482.5
1.059	Liquor Potassii Citratis	482.5
1.059	Liquor Sodæ	482.5
1.060	Oleum Cinnamomi (Oil of Cassia)	488.0

Table giving the Specific Gravities of Officinal Substances arranged in the order of their densities.—(*Continued.*)

Specific Gravity.	Officinal Name.	Weight of one Fluid-ounce in Grains.
1.060—1.070	Oleum Amygdalæ Amaræ	483.0—487.5
1.067	Acidum Sulphuricum Dilutum	486.3
1.070—1.080	Resina	
1.077	Acidum Hydrobromicum Dilutum	490.7
1.090	Oleum Sassafras	496.7
1.101—1.115	Mel (diluted with twice its weight of water)	501.7—508.1
1.135—1.150	Balsamum Peruvianum	517.2—524.0
1.160	Acidum Hydrochloricum	528.6
1.160	Liquor Ferri Acetatis	528.6
1.180	Oleum Gaultheriæ	537.7
1.212	Acidum Lacticum	552.3
1.228	Liquor Plumbi Subacetatis	559.5
1.250	Glycerinum	569.6
1.260	Liquor Ferri Citratis	574.1
1.272	Carbonei Bisulphidum	579.6
1.300	Syrupus Acidi Hydriodici	592.4
1.300—1.400	Liquor Sodii Silicatis	592.4—637.9
1.310	Syrupus	596.9
1.320	Liquor Ferri Tersulphatis	601.5
1.345	Saccharum (sat. aqueous sol. 15° C. (59° F.).)	
1.347	Acidum Phosphoricum	613.8
1.405	Liquor Ferri Chloridi	640.2
1.420	Acidum Nitricum	647.0
1.470	Chloroformum Venale	669.8
1.485—1.490	Chloroformum Purificatum	676.7—678.9
1.555	Liquor Ferri Subsulphatis	708.6
1.555	Liquor Zinci Chloridi	708.6
1.575 (at 58° C., 136° F.)	Chloral (liquefied)	717.7
1.830	Phosphorus	
1.840	Acidum Sulphuricum	838.4
2.000	Iodoformum	
2.100	Liquor Hydrargyri Nitratis	956.9
2.990	Bromum	1362.5
6.900	Zincum	
13.500	Hydrargyrum	6151.9

SPECIFIC VOLUME.

Specific volume may be defined as the *relative bulks of equal weights of different bodies*, and it is thus directly opposed to specific gravity. In pharmacy it is the volume of the weight of a liquid compared with the volume of an equal weight of water at 15° C. (59° F.). 1. *To obtain the specific volume of a liquid.*—**Rule,** Divide the volume of the given weight of the liquid by the volume of an equal weight of water, or divide the specific gravity of water (1.000) by the specific gravity of the liquid. Ex. 1420 Gm. of nitric acid measure 1000 C.c., and 1420 Gm. of water measure 1420 C.c.; then $\frac{1000}{1420}=.7042$, sp. vol. of nitric acid. 2. *To obtain the volume of a given weight of a liquid.*—**Rule,** Multiply the volume of an equal weight of water by the sp. vol. of the liquid. Ex. How many fl. oz. are there in 100 oz. av. of nitric acid? 100 oz. av. of water measure 96.01 fl. oz.; then $96.01\times.7042=67.61+$ fl. oz. of nitric acid.

Specific Volumes and actual Weights and Measures corresponding with given Specific Gravities (Dr. A. B. Lyons).

Specific gravity at 59° F., water at same temperature = 1.000.	Specific volume at 59° F.	Difference in specific volume corresponding with .001 in sp. gr.	Volume of 1:0 ounces avoirdupois in fluid-ounces.	Volume of 1000 grains in fluid-ounces.	Volume of 100 grs. in minims.	Weight of one pint in grains.	Weight of one fluidounce in grains.	Weight of one fluidounce in avoir. ounces.
.700	1.4206	.00201	137.16	3.135	150.49	5103.4	318.96	.7291
.710	1.4085	.00196	135.23	3.091	148.37	5176.3	323.52	.7395
.720	1.3889	.00190	133.35	3 048	146.31	5249.3	328.08	.7499
.730	1.3699	.00185	131 53	3.006	144.30	5322.2	332.63	.7603
.740	1.3514	.00180	129 75	2.966	142.35	5395.1	337.19	.7707
.750	1.3333	.00175	128.02	2.926	140.45	5468.0	341.75	.7811
.760	1.3158	.00171	126.33	2.888	138.61	5540.9	346 30	.7916
.770	1.2987	.00167	124.70	2.850	136.81	5613.8	350.86	.8020
.780	1.2821	.00162	123 09	2.814	135.05	5686.7	355.42	.8124
.790	1.2658	.00158	121.54	2.774	133.34	5759.6	359.97	.8228
.800	1.2500	.00155	120.02	2.743	131.68	5832.5	364.53	.8332
.805	1.2422	.00153	119.27	2.726	130.86	5868.9	366.81	.8384
.810	1.2346	.00152	118.54	2.709	130.05	5905.4	369 09	.8436
.815	1 2270	.00150	117.81	2.693	129.25	5941.9	371.37	.8488
.820	1.2195	.00148	117.09	2.676	128.46	5978.3	373.64	.8540
.825	1.2121	.00146	116.38	2.660	127.69	6014.8	375.92	.8593
.830	1.2048	.00144	115.58	2.644	126.92	6051.2	378.20	.8645
.835	1.1976	.00143	114.99	2.628	126.16	6087.7	380.48	.8697
.840	1.1905	.00141	114.30	2.613	125.41	6124.1	382.76	.8749
.845	1.1834	.00139	113.64	2.597	124.66	6160.6	385.04	.8801
.850	1.1765	.00138	112.96	2.582	123.93	6197.0	387.31	.8853
.855	1.1696	.00136	112.30	2.567	123.20	6233.5	389.59	.8905
.860	1.1628	.00134	111.64	2.552	122.49	6269.9	391.87	.8957
.865	1.1561	.00133	111.00	2.537	121.78	6306.4	394.15	.9009
.870	1.1494	.00131	110.34	2.523	121.08	6342 8	396.43	.9061
.875	1.1429	.00130	109.73	2.508	120.39	6379.3	398.71	.9113
.880	1.1364	.00128	109.11	2.494	119.70	6415.8	400.98	.9165
.885	1.1300	.00127	108.49	2.480	119.03	6452 2	403.26	.9217
.890	1.1236	.00126	107.88	2.466	118.36	6488.7	405 54	.9270
.895	1.1173	.00124	107.28	2.452	117.70	6525.1	407.82	.9322
.900	1.1111	.00123	106.68	2.438	117.05	6561.6	410.10	.9374
.905	1.1050	.00121	106.09	2 425	116.40	6598.0	412.38	.9426
.910	1.0989	.00120	105 51	2.412	115.76	6634.5	414 65	.9478
.915	1.0929	.00119	104.93	2.398	115.13	6670.9	416.93	.9530
.920	1.0870	.00118	104.36	2.385	114.51	6707 4	419.21	.9582
.925	1.0811	.00116	103.80	2.373	113.89	6743 8	421 49	.9634
.930	1.0753	.00115	103.24	2.360	113.27	6780.3	423 77	.9686
.935	1.0695	.00114	102.69	2.347	112.66	6816.7	426.05	.9738
.940	1.0638	.00113	102.14	2.335	112.06	6853 2	428.32	.9790
.945	1.0582	.00111	101.60	2.322	111.47	6889.6	430.60	.9842
.950	1.0526	.00110	101.07	2.310	110.89	6926.1	432 88	.9894
.955	1.0471	.00109	100.54	2.298	110.30	6962 5	435.16	.9946
.960	1.0417	.00108	100.15	2.286	109.73	6999.0	437.44	.9999
.965	1.0363	.00107	99.50	2.274	109 16	7035 5	439 72	1.0051
.970	1.0309	.00106	98 98	2.262	108 60	7071.9	441 99	1.0103
.975	1.0256	.00105	98.48	2.251	108.04	7108.4	444.27	1.0155
.980	1.0204	.00104	97 97	2.239	107.49	7144.8	446.55	1.0207
.985	1.0152	.00103	97.48	2.228	106.95	7181.3	448.83	1.0259
.990	1.0101	.00102	96 98	2.217	106.41	7217.7	451.11	1.0311
.995	1.0050	.00101	96 50	2 206	105.87	7254 2	453.39	1.0363
1.000	1.0000	.00099	96.01	2.195	105.34	7290.6	455.66	1.0415
1.01	.9901	.00097	95 06	2.173	104.30	7363.5	460 22	1.0519
1.02	.9804	.00095	94.13	2.152	103.28	7436.4	464 78	1.0623
1.03	.9709	.00093	93.22	2.131	102.27	7509.3	469.33	1.0728
1.04	.9615	.00091	92.32	2.110	101.29	7582.3	473.89	1.0832
1.05	.9524	.00090	91.45	2.090	100.33	7655.2	478.45	1.0936
1.06	.9434	.00088	90.58	2.070	99 38	7728.1	483.00	1.1040
1.07	.9346	.00087	89 73	2.051	98 45	7801.0	487.56	1.1144
1.08	.9259	.00085	88.90	2.032	97.54	7873.9	492.12	1.1248
1.09	.9174	.00083	88.09	2 013	96.64	7946 8	496.67	1.1353
1.10	.9091	.00082	87 29	1.995	95.76	8019.7	501.23	1.1457
1.11	.9009	.00080	86.50	1.977	94.90	8092.6	505 79	1.1561
1.12	.8929	.00079	85.73	1.960	94.00	8165.5	510.34	1.1665
1.13	.8850	.00078	84.97	1.942	93.22	8238.4	514.90	1.1769
1.14	.8772	.00076	84.22	1.925	92.40	8311.3	519.46	1.1873
1.15	.8696	.00075	83.49	1 908	91.60	8384 2	524.01	1.1977
1.16	.8621	.00074	82.77	1.892	90.81	8457.1	528.57	1.2082
1.17	.8547	.00072	82.06	1.876	90 03	8530.0	533.13	1.2186
1.18	.8475	.00071	81.37	1.860	89.27	8602.9	537.68	1.2290
1.19	.8403	.00070	80.69	1.844	88.52	8675.8	542.24	1.2394
1.20	.8333	.00069	80.01	1.829	87.78	8748.8	546.80	1.2498
1.21	.8265	.00068	79.35	1.814	87.06	8821.7	551.35	1.2602

Specific Volumes and actual Weights and Measures.—(*Continued.*)

Specific gravity at 59° F., water at same temperature = 1.000.	Specific volume at 59° F.	Difference in specific volume corresponding with .001 in sp. gr.	Volume of 100 ounces avoirdupois in fluid-ounces.	Volume of 1000 grains in fluid-ounces.	Volume of 100 grs. in minims.	Weight of one pint in grains.	Weight of one fluidounce in grains.	Weight of one fluidounce in avoir. ounces.
1.22	.8197	.00067	78.70	1.799	86.34	8894.6	555.91	1.2707
1.23	.8130	.00066	78.06	1.784	85.64	8967.5	560 47	1.2811
1 24	.8065	.00064	77.43	1.770	84 95	9040.4	565.02	1.2915
1.25	.8000	.00063	76.81	1.756	84.27	9113.3	569.58	1.3019
1.26	.7937	.00063	76.20	1.742	83.60	9186.2	574.14	1.3123
1.27	.7874	.00062	75.60	1.728	82.95	9259.1	578.69	1.3227
1.28	.7813	.00061	75.01	1.715	82.30	9332.0	583.25	1.3331
1.29	.7752	.00060	74.43	1.701	81 66	9404.9	587.81	1.3436
1.30	.7692	.00058	73.86	1.688	81.03	9477.8	592.36	1.3540
1.31	.7634	.00058	73.29	1.675	80.41	9550 7	596.92	1.3644
1.32	.7576	.00057	72.74	1.663	79.81	9623.6	601.48	1.3748
1.33	.7519	.00056	72.20	1.650	79.21	9696.5	606.03	1.3852
1.34	.7463	.00056	71.65	1.638	78.61	9769.4	610.59	1.3956
1.35	.7407	.00054	71.12	1.626	78.03	9842 3	615.15	1.4060
1.36	.7353	.00054	70.60	1.614	77.46	9915.3	619.70	1.4165
1.37	.7299	.00053	70.08	1.602	76.89	9988.2	624.26	1.4269
1.38	.7246	.00052	69.58	1.590	76 33	10061.1	628.82	1 4373
1.39	.7194	.00051	69.08	1.579	75.78	10134.0	633.37	1.4477
1.40	.7143	.00051	68.58	1.568	75.24	10206.9	637.93	1.4581
1.41	.7092	.00050	68.10	1.557	74.71	10279.8	642.49	1.4685
1.42	.7042	.00049	67.62	1.546	74.18	10352.7	647.04	1.4790
1.43	.6993	.00049	67.14	1.535	73.67	10425.6	651.60	1 4894
1.44	.6944	.00048	66.68	1.524	73.15	10498.5	656.16	1.4998
1.45	.6896	.00047	66.22	1.514	72.65	10571.4	660.71	1.5102
1.46	.6849	.00046	65.76	1.503	72.15	10644.3	665 27	1.5206
1.47	.6803	.00046	65.32	1.493	71.66	10717.2	669.83	1.5310
1.48	.6757	.00045	64.87	1.483	71.18	10790.1	674.38	1.5414
1.49	.6712	.00045	64.44	1.473	70.70	10863 0	678.94	1.5519
1.50	.6667	.00044	64.01	1.463	70 23	10935.9	683.50	1.5623
1.51	.6623	.00044	63.59	1.453	69.76	11008.8	687.95	1.5727
1.52	.6579	.00043	63.17	1.444	69.30	11081.8	692.51	1.5831
1.53	.6536	.00042	62.75	1.434	68.85	11154.7	697.07	1.5935
1.54	.6494	.00042	62.35	1.423	68.40	11227.6	701.62	1.6039
1.55	.6452	.00042	61.95	1.416	67.96	11300.5	706.18	1.6144
1.56	.6410	.00041	61.55	1.407	67.53	11373.4	710.74	1.6248
1.57	.6369	.00040	61.13	1.398	67.10	11446.3	715.39	1.6352
1.58	.6329	.00040	60 77	1.389	66.67	11519.2	719.95	1.6456
1.59	.6289	.00039	60.39	1.380	66.25	11592.1	724.51	1.6560
1.60	.6250	.00039	60.01	1.372	65.84	11665.0	729.06	1.6664
1.61	.6211	.00038	59.64	1.363	65.43	11737.9	733.62	1 6768
1.62	.6173	.00038	59.27	1.355	65.02	11810.8	738.18	1.6873
1.63	.6135	.00037	58.90	1.346	64.63	11883.7	742.73	1.6977
1.64	.6098	.00037	58.55	1.338	64.23	11956.6	747.29	1.7081
1.65	.6061	.00037	58.19	1.330	63.84	12029.5	751.85	1.7185
1.66	.6024	.00036	57 84	1.322	63.46	12102.4	756.40	1.7289
1.67	.5988	.00036	57.49	1.314	63.08	12175.3	760.96	1.7393
1.68	.5952	.00035	57.15	1.306	62.70	12248.3	768.52	1.7498
1.69	.5917	.00035	56.81	1.299	62.33	12321.2	770.07	1.7602
1.70	.5882	.00034	56.48	1.291	61.97	12394.1	774.63	1.7706
1.71	.5848	.00034	56.15	1.284	61.60	12467.0	779.19	1.7810
1.72	.5814	.00034	55.79	1.276	61.24	12539.9	783.74	1.7914
1.73	.5780	.00033	55.50	1.269	60.89	12612.8	788.30	1.8018
1.74	.5747	.00033	55.18	1.261	60.54	12685.7	792.86	1.8122
1.75	.5714	.00032	54.87	1.254	60.19	12758.6	797.41	1.8227
1.76	.5682	.00032	54.55	1.247	59.85	12831.5	801.97	1.8331
1.77	.5650	.00032	54.25	1.240	59.51	12904.4	806.53	1.8435
1.78	.5618	.00031	53.94	1.233	59.18	12977.3	810.08	1.8539
1.79	.5587	.00031	53.64	1.226	58.85	13050 2	815 64	1.8643
1.80	.5556	.00031	53.34	1.219	58.52	13123.1	820.20	1.8747
1.81	.5525	.00030	53.05	1.213	58.20	13196.0	824.75	1.8851
1.82	.5495	.00030	52.76	1.206	57.88	13268.9	829.31	1.8956
1.83	.5465	.00030	52.47	1.200	57.56	13341.8	833.87	1.9060
1.84	.5435	.00030	52.18	1.193	57.25	13414.8	838.42	1.9164
1.85	.5405		51.90	1.186	56.94	13487.7	842.98	1.9268

The third column is used for supplying figures not specified in the table. For instance, if the sp. vol. of carbon bisulphide having sp. gr. 1.272 is desired: the nearest sp. gr. is 1.270 and the corresponding sp. vol. .7874; the difference in sp. vol. corresponding with .001 in sp. gr. given in the next column is .00062. Now, 1.272 — 1.270 = 0.002; then .00062 × 2 = .00124, and .7874 — .00124 = .78616, sp. vol. of carbon bisulphide. Again, if the volume of 100 oz. av. of the same liquid is desired, column 4 gives the volume of a liquid of 1.270 sp. gr. as 75.60 fl. oz. The correction for a difference of .001 in specific gravity is found by subtracting the succeeding term from the volume corresponding with sp. gr. 1.270 (removing the decimal point one place to the left), multiplying the remainder by 2, and subtracting this from the volume corresponding with sp. gr. 1.270: thus, 75.60 — 75.01 = .59; then .059 × 2 = .118, and 75.60 — .118 = 75.482 fl. oz., the volume of 100 oz. av. carbon bisulphide.

Formulas for Increasing or Decreasing the Strength of Liquids to any Desired Degree, and for the Preparation of Liquids of a fixed Specific Gravity without the use of Percentage Tables.

The introduction of the principle of "parts by weight" into the U. S. Pharmacopœia, and the frequent necessity in laboratory work for adjusting liquids of different densities, have been the inducements for inserting the following rules of Claassen:

I. *Given a liquid of known weight and percentage. Required to know the quantity of a liquid of the same kind, of higher or lower percentage, or of water, which will have to be added, to produce a desired percentage.*

Let a be the quantity of the given liquid; b its percentage of important constituent; c the percentage of the liquid to be mixed with a; d the desired percentage of the mixture; x the quantity of the liquid, of higher or lower percentage, or the quantity of water, to be added to a. Then we have—

1. $x = \frac{a\,(b-d)}{d-c}$, if the liquid to be added is of higher or lower percentage; or, in words,—

To find x (the quantity of liquid to be added), multiply the difference between the percentage of the liquid a and the desired percentage of the mixture by the quantity of the liquid a, and divide the product by the difference between the desired percentage and that of the liquid to be mixed with a.

Example.—Suppose 40 parts of a liquid of 50 per cent. are to be mixed with a liquid of 20 per cent. in order to get one of 30 per cent., how much of the liquid of 20 per cent. must be added?

x (the quantity of the liquid of 20 per cent.) $= \frac{40\,(50-30)}{30-20} = \frac{40\times 20}{10} = 80.$

2. $x = \frac{a\,(b-d)}{d}$, if water must be added; or, in words,—

To find x (the quantity of water to be added), proceed as described under 1, but divide the product by the desired percentage only.

Example.—Suppose 40 parts of a liquid of 50 per cent. are to be mixed with water in order to get one of 30 per cent., how much water must be added?

x (the quantity of water) $= \frac{40\,(50-30)}{30} = \frac{40\times 20}{30} = \frac{800}{30} = 26\frac{2}{3}.$

II. *Given two liquids of the same kind, one of higher and the other of lower percentage; or one of any percentage, the other being water. Required to know the quantity of the weaker liquid, to be added to the stronger, to produce a desired weight and percentage.*

Let a be the desired weight or quantity of the mixed liquids; b the percentage of the stronger liquid; c the percentage of the weaker liquid; d the percentage of the mixture; x the weight of the weaker liquid, or of water, to be added to the stronger. Then we have—

1. $x = \frac{a\,(b-d)}{b-c}$, if a stronger liquid is to be mixed with a weaker one; or, in words,—

To find x (the quantity of the weaker liquid), multiply the difference between the percentage of the stronger liquid and the desired percentage of the mixture, and divide the product by the difference between the percentage of the stronger and that of the weaker liquid.

Example.—Suppose a liquid of 60 per cent. and another of 20 per cent. are used, 40 parts of a liquid of 30 per cent. being the object sought, how much of the liquid of 20 per cent. must be taken?

x (the quantity of the weaker liquid) $= \frac{40\,(60-30)}{60-20} = \frac{40\times 30}{40} = 30.$

Then the quantity of the stronger liquid will be 10 parts to make the desired 40 parts.

2. $x = \frac{a\,(b-d)}{b}$, if a stronger liquid must be mixed with water; or, in words,—

To find x (the quantity of water to be added), proceed as described under II., 1, but divide the product by the percentage of the stronger liquid only.

Example.—Suppose a liquid of 60 per cent. is used, 40 parts of a liquid of 30 per cent. being the object sought, how many parts of water must be taken?

x (the quantity of water) $= \frac{40\,(60-30)}{60} = \frac{40\times 30}{60} = 20.$ In other words, 20 parts of water must be mixed with 20 parts of the given liquid.

In applying the same principle to the cases of liquids having different specific gravities, and substituting volume or measure for weight, care must be observed not

to rely absolutely upon the accuracy of the following rules *if contraction in volume takes place when the liquids are mixed together*, as when alcohol is diluted with water.

III. *Given a liquid of known quantity and specific gravity. Required to know the quantity of a liquid of the same kind of higher or lower specific gravity, or of water, which will have to be added to produce a desired specific gravity.*

Let a be the quantity of the given liquid; b its specific gravity; c the specific gravity of the liquid to be mixed with a, or of water; d the desired specific gravity of the mixture; x the quantity of the liquid of the same kind of higher or lower specific gravity, or of water, to be added to a.

Then we have $x = \frac{a\,(b-d)}{d-c}$; or, in words,—

To find x (the quantity of the liquid or of water to be added), multiply the difference between the specific gravity of the liquid a and the desired specific gravity of the mixture by the quantity of the liquid a, and divide the product by the difference between the desired specific gravity and that of the liquid (or of water) to be mixed with a.

Example 1.—Suppose 40 parts of a liquid of 1.45 specific gravity are to be mixed with a liquid of 1.23 specific gravity in order to get one of 1.30 specific gravity, how much of the liquid of 1.23 specific gravity must be added?

$$x = \frac{40\,(1.45-1.30)}{1.30-1.23} = \frac{40\times 0.15}{0.07} = \frac{40\times 15}{7} = \frac{600}{7} = 85\tfrac{5}{7}.$$

$85\frac{5}{7}$ parts of a liquid of 1.23 specific gravity must be added to 40 parts of the liquid of 1.45 specific gravity to make a liquid of 1.30 specific gravity.

Example 2.—Suppose 40 parts of a liquid of 1.45 specific gravity are to be mixed with water in order to get one of 1.30 specific gravity, how much water must be added?

$$x = \frac{40\,(1.45-1.30)}{1.30-1.00} = \frac{40\times 0.15}{0.30} = \frac{40\times 15}{30} = \frac{600}{30} = 20.$$

20 parts of water must be added to 40 parts of a liquid of 1.45 specific gravity in order to get one of 1.30 specific gravity.

IV. *Given two liquids of the same kind, one of higher and the other of lower specific gravity, or one of any specific gravity, the other being water. Required to know the quantity of the liquid to be added to the other, or of water to be added to the liquid on hand, to produce a desired quantity and specific gravity.*

Let a be the desired quantity of the mixed liquids; b the specific gravity of one of the liquids; c the specific gravity of the other liquid, or of water to be added to b; d the specific gravity of the mixture; x the quantity of one of the liquids, or of water to be added to the other liquid.

Then we have $x = \frac{a\,(b-d)}{b-c}$; or, in words,—

To find x (the quantity of the liquid c, or of water, to be added to the liquid b), multiply the difference between the specific gravity of the liquid b and the desired specific gravity of the mixture by the quantity a of the liquid given, and divide the product by the difference between the specific gravity of the liquid b and that of the liquid c or of water.

Example.—Suppose a liquid of 0.960 specific gravity, and another of 0.880 specific gravity, are used, 40 parts of a liquid of 0.905 specific gravity being the object sought.

(1) How much of the liquid c (the liquid of 0.960 specific gravity in this example) must be taken?

$$x = \frac{40\,(0.880-0.905)}{0.880-0.960} = \frac{40\times -0.025}{-0.080} = \frac{40\times 25}{80} = \frac{25}{2} = 12\tfrac{1}{2}.$$

$12\frac{1}{2}$ parts of the liquid of 0.960 specific gravity must be mixed with $40-12\frac{1}{2} = 27\frac{1}{2}$ parts of the liquid of 0.880 specific gravity in order to get 40 parts of a liquid of 0.905 specific gravity, as the following will also show:

(2) How much of the liquid c (the liquid of 0.880 specific gravity in this example) must be taken?

$$x = \frac{40\,(0.960-0.905)}{0.960-0.880} = \frac{40\times 0.055}{0.080} = \frac{40\times 55}{80} = \frac{55}{2} = 27\tfrac{1}{2}.$$

$27\frac{1}{2}$ parts of the liquid of 0.880 specific gravity must be mixed with $40-27\frac{1}{2} = 12\frac{1}{2}$ parts of the liquid of 0.960 specific gravity in order to get 40 parts of a liquid of 0.905 specific gravity.

Example.—Suppose a liquid of 0.905 specific gravity is used, 40 parts of a liquid of 0.960 specific gravity is the object sought, how much water must be taken?

$$x = \frac{40\,(0.905-0.960)}{0.905-1.000} = \frac{40\times 0.055}{0.095} = \frac{40\times 55}{95} = \frac{2200}{95} = 23\tfrac{15}{19}.$$

$23\frac{15}{19}$ parts of water must be mixed with $40-23\frac{15}{19} = 16\frac{4}{19}$ parts of the liquid of 0.905 specific gravity in order to get 40 parts of a liquid of 0.960 specific gravity.

CHAPTER II.

OPERATIONS REQUIRING THE USE OF HEAT.

Generation of Heat.

THE consideration of the theories which have been advanced from time to time to explain the phenomenon of heat, although very interesting and instructive, cannot be treated of in a work of this character, and the reader is therefore referred to any of the recent works on physics, which are everywhere accessible. The view which is now almost universally accepted is that known as the dynamical theory of heat, in which it is assumed that heat is produced by the constant motion of the particles composing the body, and that heat varies in quantity and kind according as the body is *solid*, *liquid*, or *gaseous*.

It will be convenient to consider the various practical operations and appliances for generating heat under three heads:

1. Operations and forms of apparatus in which *solids* are used in developing heat.
2. Those in which *liquids* are used in developing heat.
3. Those in which *gases* are used in developing heat.

OPERATIONS AND FORMS OF APPARATUS IN WHICH SOLIDS ARE USED IN DEVELOPING HEAT.

Kinds of Fuel.—Under this head is included the very well known employment of solid fuel, as wood, charcoal, anthracite coal, bituminous coal, coke, etc.

Wood is seldom relied upon as fuel in pharmaceutical operations where a regular, well-sustained heat is desired, yet from its wide distribution, ready inflammability, and comparative cheapness it is indispensable in kindling a fire. The large quantity of unconsumed carbon which is either lost in smoke or deposited upon vessels that are being heated constitutes the chief objection to its use.

Charcoal is more convenient, although more costly, than wood: it ignites easily, burns readily, and leaves but little residue. On account of its ready combustibility, it is well fitted for operations requiring a quick, strong heat.

Anthracite coal is probably the best form of solid fuel for general use, being the most economical: its hard, dense structure renders it difficult

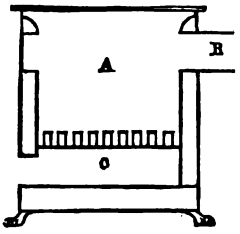
to kindle, but where a long-continued, strong heat is desired it is to be preferred.

Bituminous or *semi-bituminous coal* affords a strong heat, but it is not equal to anthracite as fuel for pharmaceutical purposes. Unconsumed carbon is found in the smoke in large quantity, and this is apt to condense on the surfaces of kettles, vessels, etc., which are being heated, and the deposits of soot are uncleanly and often difficult to remove.

Coke, the residue obtained from the distillation of coal at gas-works, is an excellent fuel, and may be used either mixed with coal or by itself: it is more easily kindled than anthracite.

Pharmaceutical Furnaces, etc.—Much ingenuity has been used in the contrivance of various forms of furnaces, ranges, stoves, etc., to meet general or special applications, yet in all there are certain fundamental principles of construction which must be well understood if faults are to be avoided. The elements of a furnace are the *air-flue*, *combustion-chamber*, and *vent* or *chimney*, and the relative proportions of these must depend upon the special object sought in the construction of the furnace, and the character of the fuel that is to be used. Fig. 51 represents a sectional view of a pharmaceutical furnace,—C being the air-flue, A the combustion-chamber, and B the vent.

FIG. 51.



Pharmaceutical furnace (sectional view).

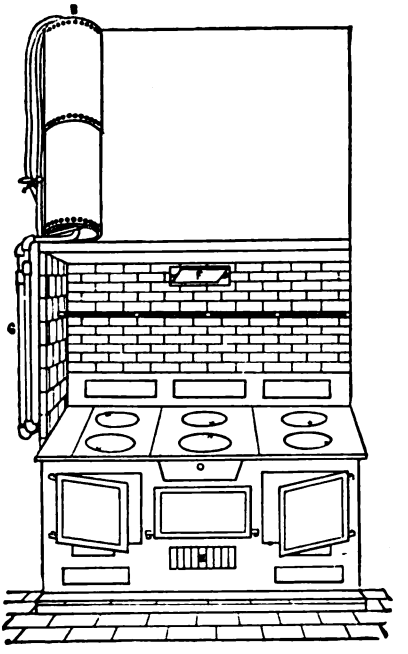
Coal being the principal solid fuel in use, it will be most appropriate to treat of those furnaces adapted for its combustion, and therefore the chemical constitution of coal and the theory of its combustion must be noticed. Hard anthracite, which is the best kind of coal for pharmaceutical furnaces, usually has a specific gravity of 1.550, and has been shown to consist of 94 per cent. carbon, 0.40 per cent. hydrogen, and 1.26 per cent. oxygen; there are also apt to be present 2 per cent. of water and about 2.3 per cent. of incombustible impurities or ash, consisting of ferric oxide, silica, alumina, magnesia, lime, etc. The poorer grades of this kind of coal contain from 85 to 90 per cent. of carbon. Anthracite may be distinguished from other varieties by its rich, glassy lustre, its peculiar conchoidal fracture, and its hard, dense structure: it burns freely, without black smoke, showing the absence of unconsumed carbon. Soft anthracite or *semi-bituminous* coal has a tendency, when broken into pieces, to assume the form of irregular cubes, and to crumble easily when pressed: it burns freely, but with the production of large quantities of black smoke. The heat produced by its combustion is very strong, and it is largely used in many parts of the United States.

The combustion or oxidation of coal requires the presence of a certain quantity of air in contact with the burning coal to furnish enough oxygen to combine properly with the carbon of the fuel. The result of the combination is carbon dioxide, CO_2, and carbon monoxide, CO, both of which are gases. It is very important to provide means of escape for these gaseous compounds, as they are both poisonous, and the former is a decided non-supporter of combustion. Theoretically, it has been calculated that one hundred and fifty cubic feet of air are necessary to

consume perfectly one pound of coal in an ordinary furnace, but practically, because of the obstruction of the ashes, which prevents the thorough contact of the air with all parts of the glowing carbon, nearly double this amount is necessary.

Stoves and ranges are now so universally used that it would be needless to multiply illustrations of them: the proper selection of such as are suited to the special uses of the pharmacist must be left to individual decision, and will depend upon the space that can be spared and the character of the work that is to be done. One important feature should not be overlooked, however, in this connection,—*i.e.*, the addition of a boiler or water-back, whereby a constant supply of hot water can be had: where stoves are used, this can generally be effected by having a circulating hot-water boiler in a convenient corner, the pipes conveying the hot water being heated in the upper part of the combustion-chamber of the stove. If sufficient space can be appropriated, a range is very useful, particularly if a sheet-iron sliding-door can be lowered over the front to enclose the space. Now, when a communicating flue, controlled by a damper, is made to enter the chimney from the top of this space, operations can be conducted here that would otherwise be impossible, noxious vapors being at once carried off by the flue. Fig. 52 represents an ordinary range which is well adapted for many pharmaceutical operations. The front has been removed, in order to show the construction more clearly. This front is of sheet iron, and is hinged to the shelf which supports the boiler; it extends half-way over the top of the range, and when the damper, F, is opened, the vapors arising from operations conducted on the top are carried up the chimney. The hot-water boiler, B, is connected by pipes, G, with the cold-water supply in such a manner that the cold water circulates through pipes which surround the combustion-chamber, and, after becoming heated, ascends into the boiler.

FIG. 52.

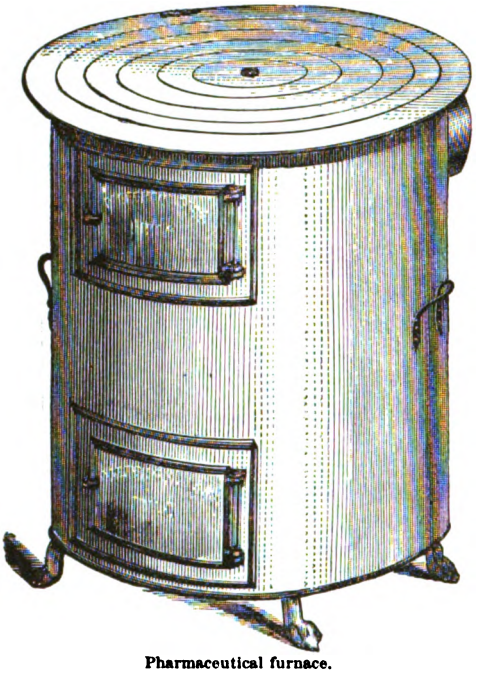


Pharmaceutical range.

Fig. 53 shows a durable pharmaceutical furnace made by Mershon's Sons, which has proved very useful in practical work. The body of the furnace is of wrought iron; it is lined with fire-brick, and the top is composed of a series of rings, which permits of the use of various-sized kettles, evaporating-dishes, etc. It has two cast-iron doors, the upper one being especially useful, as it permits the ready feeding of coal to the furnace whilst a kettle or dish is being heated, without disturbing the

latter. Fig. 51 affords a sectional view of the same furnace; and it will be noticed that the combustion-chamber, A, is sufficiently deep to contain a considerable body of ignited coal and permit the introduction of hot-water pipes. The proportion of the air-flue, C, is well arranged, whilst the vent, B, has sufficient capacity to serve all pharmaceutical purposes.

FIG. 53.



Pharmaceutical furnace.

The merits of this furnace are that the greater part of the heat rises and is available for heating the vessel placed on the rings, the heavy lining of fire-brick preventing lateral radiation to a great extent, and that, while it has all the advantages of a stationary furnace, its position can be changed repeatedly if desired, the relative proportion being so well adjusted that, whilst it is very sensitive to an increase or decrease of draught, a moderate heat may be as steadily maintained as the intensity of a strong fire.

A drying-closet can be adapted to this stove by which the waste heat may be utilized. This will be described in the chapter on desiccation.

OPERATIONS AND FORMS OF APPARATUS IN WHICH LIQUIDS ARE USED IN DEVELOPING HEAT.

The liquids which are most used in pharmaceutical operations for heating are alcohol, petroleum, or coal oil, and benzin, or gasolin. All of these liquids contain carbon and hydrogen, whilst alcohol contains thirty-four per cent. of oxygen in addition.

Alcohol burns with a blue flame, which does not deposit soot, and the heat produced is intense. It is in many respects the best liquid to use for generating heat in small operations, but the expense attending its use in this country is a serious objection; for this reason it is more economical to use a glass spirit-lamp, which is provided with a ground-glass cap (see Fig. 54), than an extemporaneous lamp made from an ordinary bottle: in the latter the loss by the evaporation of the alcohol from the wick, which is exposed when the lamp is not in use, is considerable. The older forms of alcohol-lamps, such as Berzelius's, Mitchell's, etc., have almost gone out of use, being superseded by improved forms.

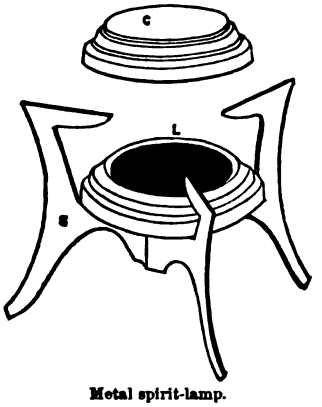
FIG. 54.

Spirit-lamp.

Fig. 55 shows one of the simplest of these very convenient spirit-lamps. L represents the lamp, S the support, and C the cover. Alcohol is poured upon the brass-wire gauze, which sinks into and is absorbed by the asbestos, or mineral wool, with which the body of the brass disk is filled; a lighted match is now applied to the gauze, which retains sufficient spirit to ignite, and a strong heat is at once obtained, the large extent of surface of the gauze producing a solid blue flame. The great advantages of spirit-lamps of this kind are that, all parts being of metal, accidents from breakage are avoided, whilst explosions cannot occur, as neither the alcohol nor its vapor is confined in a tight receptacle, and if the lamp is upset accidentally no spirit can be spilled, because it is absorbed by the asbestos. The stand, S, is hinged in the centre, and the cap, C, fits tightly on the lamp, so that loss by evaporation is prevented when not in use: all the parts of the lamp fit into a box, which may be readily carried in the pocket. Many modifications of this simple contrivance have been introduced which are elaborate and useful, but want of space prevents further notice.

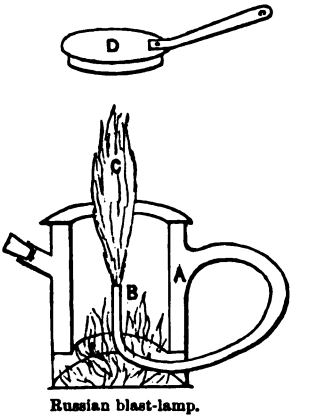
The so-called Russian blast-lamp is one of the best contrivances for generating an intense heat: it is useful when glass tubes of large diameter are to be bent, or in crucible operations. A sectional illustration is seen in Fig. 56. It is made of sheet copper, and consists of a partially-jacketed cylinder, A, with an opening on one side for introducing the

Fig. 55.



Metal spirit-lamp.

Fig. 56.



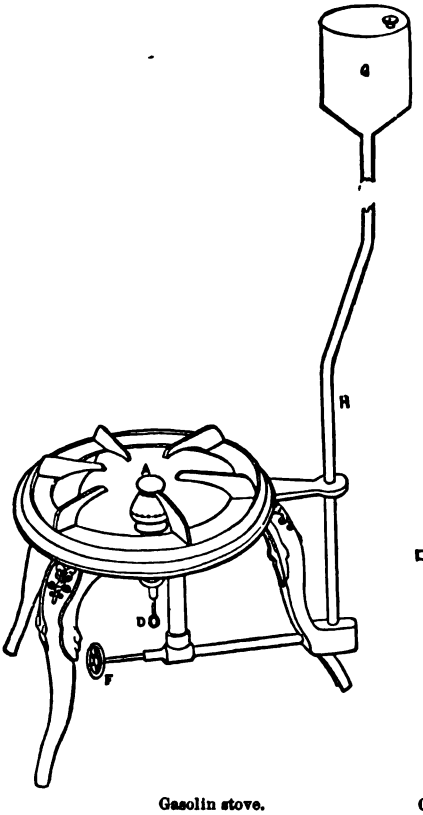
Russian blast-lamp.

alcohol, and on the opposite side a bent, tapering tube, B, which pierces the cylinder below the jacketed portion, and is turned upward as shown in the cut. The principle of action is that of the combustion of the *vapor* of the spirit. If sufficient alcohol is poured into the lamp through the side opening to half fill it, the cork loosely inserted, and half a fluidounce of alcohol poured into the large opening at the top, and then a lighted match dropped into it, the heat from the burning alcohol in the bottom of the lamp causes the alcohol contained between the jacketed sides to boil, and the vapor, having but one means of escape, rushes out by the tapering, bent tube, and at once ignites and produces a powerful

upward blast. The flame, C, may be at once extinguished by putting the cover, D, over the central opening.

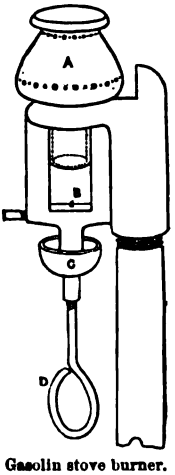
Benzin, or *Gasolin*, is now used for heating purposes, and Fig. 57 shows one of the most convenient stoves for employing this cheap but very volatile hydrocarbon. The difficulties in the use of the very inflammable and often dangerous liquids of this class for heating have been here largely overcome: to avoid a smoky, luminous flame the *vapor is burned in contact with air*, whilst to prevent explosions the reservoir for the liquid is elevated and placed four or five feet away from the ignited vapor. Fig. 57 shows the stove, and Fig. 58 an enlarged view of the burner. The reservoir, G, is filled with gasolin, care being taken at the same time to see that the valve F is closed. When the burner is to be lighted, the valve F is opened slightly, and the valve D turned very carefully, so that a small quantity of gasolin shall flow from B over the sides and collect in the cup, C. When C is full, both valves, F and D, are turned off, and a lighted match applied to C; the burning gasolin will heat the burner, A; and when all of the liquid in C has been burned and the flame extinguished, the valve D is turned on slightly and a lighted match applied at A; the parts surrounding B being hot, the gasolin *is vaporized*, and passing upward through the burner, A, issues through the numerous circular openings and is ignited; the upward current of air caused by the heat mixes with the gasolin vapor and supplies the oxygen necessary to produce a perfectly blue and intensely hot flame, the size of which is regulated by the valves D and F. When fairly ignited, F is slightly opened, and D is used to control the flame by turning to the right or left.

FIG. 57.



Gasolin stove.

FIG. 58.



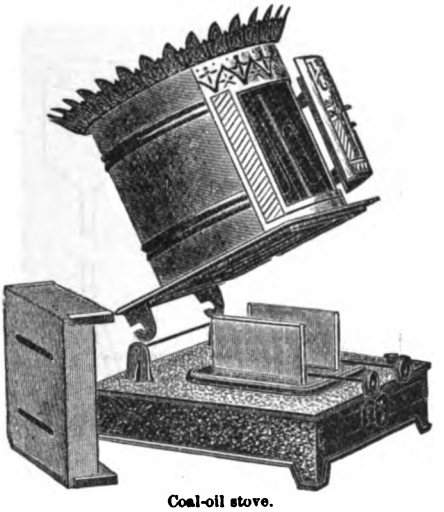
Gasolin stove burner.

Although this stove is safe in careful hands, the volatile and very inflammable character of the hydro-carbon must be constantly borne in mind. In a large laboratory in the southern part of Philadelphia these

burners are exclusively used, an elevated tank in the yard supplying the gasolin to the gas-pipes, which are conveniently laid around the sides of the room and communicate with the burners on the tables.

Kerosene, or *Coal Oil*, is so widely known as a refined petroleum product used for illuminating and heating purposes that any extended notice of its properties in a practical work would be superfluous; as it is heavier in specific gravity and has a much higher flashing-point[1] than gasolin, it is much safer for popular use. A pharmaceutical stove in which coal oil can be burned with a blue flame safely, and without the use of wicks, is yet to be contrived. There are a great many stoves to be had which are wick-burners, but these are often unsatisfactory: they are largely used, however, notwithstanding their inconveniences. Fig. 59 shows one of the best forms of this class. It is made by Adams & Westlake. The oil is poured into a reservoir in the base of the stove, the upper part is surrounded with perforated tin, which admits air to the flame and acts as a protection; the wicks, which are flat and wide, have corresponding chimneys, by which the heat is conveyed to the vessel that is to be heated. The disadvantage common to all coal-oil stoves using wicks is that the chimneys have to be high enough to secure perfect combustion and prevent smoking, and this removes the vessel that is to be heated so far from the flame that quick heating is almost impossible; in addition to this, the wicks require constant attention, and imperfect combustion frequently results even when care is exercised. In sections of our country where gas cannot be had, they are, however, indispensable, and are the most convenient generators of heat attainable.

FIG. 59.



Coal-oil stove.

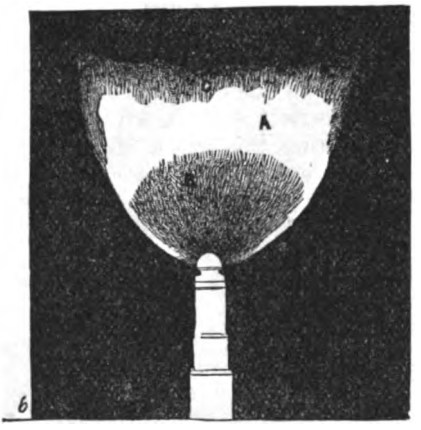
OPERATIONS AND FORMS OF APPARATUS IN WHICH GASES ARE USED IN DEVELOPING HEAT.

Gas.—The extensive employment of manufactured illuminating gas and the growing use of natural gas as sources of heat for pharmaceutical and other purposes render necessary a somewhat extended notice of gas in this connection. Illuminating gas is frequently called carburetted hydrogen, but it is really a mechanical mixture of various gases, some of which produce luminous flames and others do not; besides the hydrocarbon, CH_4 (carburetted hydrogen), which is the principal constituent,

[1] By this term is meant the temperature at which coal oil begins to give off inflammable vapor.

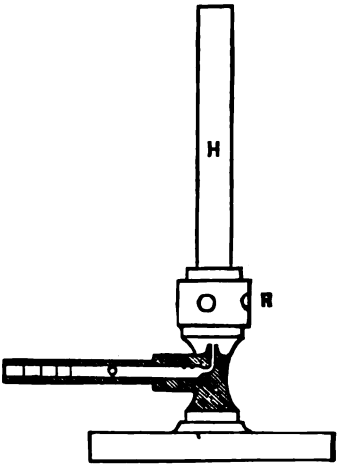
it contains condensible hydrocarbons, hydrogen, carbon dioxide, carbon monoxide, aqueous vapor, and traces of oxygen and nitrogen. Gas is usually produced by the destructive distillation of gas-coal, whilst coal-tar, gas-liquor, and coke are the liquid and solid by-products, and these are now exceedingly useful as the sources of valuable manufactures in the arts. Gas which is fitted for illuminating purposes must have its composition modified by admixture with air before it is fit for heating purposes; this may be best illustrated by the examination of an ordinary fish-tail gas-flame. In Fig. 60 it will be noticed that three zones are visible,—B, the dark central zone, which is not luminous and not at all

FIG. 60.



Gas-flame.

FIG. 61.



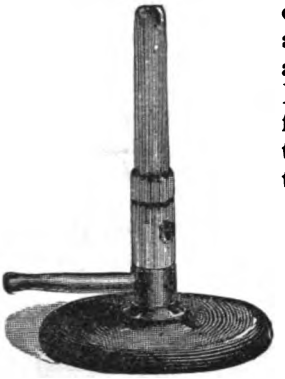
Bunsen burner (sectional view).

hot, because the gas is not fairly ignited; A, the luminous zone, where the emission of light is due to the suspension of minute particles of incandescent carbon in the flame, caused by the incomplete combustion of the gas; C, the outer non-luminous zone, the "mantle" which fringes the flame and where the particles of carbon coming in direct contact with the air are entirely consumed, the commonly accepted theory being that the oxygen in the air unites chemically with the incandescent carbon-particles, producing the invisible gases carbon monoxide and carbon dioxide.

Soon after gas came into use it was discovered that the properties which rendered it most valuable as an illuminator prevented its use as a source of heat, because of the deposition of the particles of soot from the luminous portion of the flame upon vessels that were to be heated. Dr. Duncan, of Edinburgh, showed that if gas properly mixed with air was made to enter at the bottom of a tall tinned iron cylinder, the upper end of which was covered with wire gauze, it would burn when ignited above the gauze with a blue, smokeless flame. The unnecessarily long cylinders (sometimes thirty inches) which were originally used were soon replaced by others of the length of five or six inches, for the sake of greater convenience. This discovery was at once utilized, and gas stoves and burners for various purposes came into use immediately.

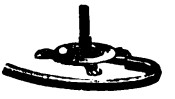
Bunsen burners are more frequently used in simple operations than any other form (see Fig. 61). The coal-gas issues from a small orifice, O, near the base, passes up through a brass tube, H, four inches high, and is ignited at the top of this tube; four large circular openings surround the small orifice at the base, and these may be closed either wholly or in part by a perforated brass ring, R; this permits the regulation of the supply of air, which mixes with the gas as it ascends the tube, and a blue, smokeless, intensely hot flame may be produced; if the perforated ring is turned so that the air-openings are closed, a luminous, smoky flame results. One of the objections to the ordinary Bunsen burner is that, after being used for a time under a low gas-pressure, when the tube becomes hot the flame will sometimes recede and the gas become ignited at the lower orifice: this may usually be avoided by gradually turning the brass perforated ring, so as to admit less air to suit the diminished pressure. Prof. Morton corrects this receding of the flame by contracting the orifice of escape at the top to about two-thirds of the area of the tube see Fig. 62). That the length of the perpendicular tube does not materially affect the smokeless character of the flame may be proved by the use of the convenient little burners shown in Figs. 63 and 64. These are made by the Buffalo Dental Manufacturing Company, and have proved very useful at the prescription counter. Bunsen burners with the tube arranged horizontally have grown in favor because they are less likely to be overturned, and if they have a broad base they will easily support a large vessel. Fletcher's

Fig. 62.



Bunsen burner (Morton's).

Fig. 63.

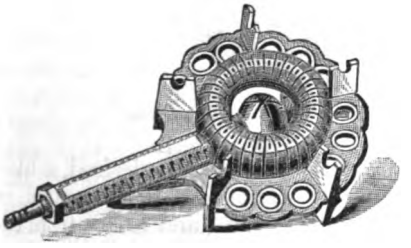


Short burner.

Fig. 64.

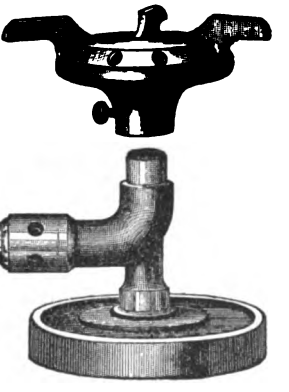
Short burner, with support.

Fig. 66.



Fletcher's radial burner.

Fig. 67.



Horizontal Bunsen burner.

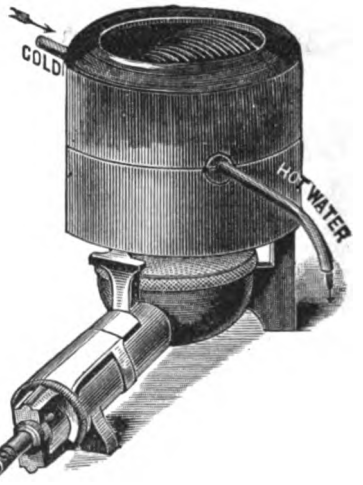
radial burner (see Fig. 66) has the merit of having no loose parts, and, as the casting is well annealed, it is well adapted for rough usage, the gas issuing from narrow slits cut radially in the raised circular burner; the flame is solid and non-luminous: no gauze is needed to distribute the heat. In Fig. 67 is shown a very compact and useful gas-burner, well adapted for the dispensing counter, made by Bullock & Crenshaw; it is of the horizontal Bunsen type, and is furnished with an attachment for distributing the flame, and three short legs for supporting the vessel that is to be heated.

Gas stoves are now made in such variety that it seems difficult to make a judicious selection for general pharmaceutical work: the error most frequently made is in the choice of those which are intended to produce only very high temperatures. It is very seldom that a heat of great intensity is desired in pharmaceutical operations. The chief points to be secured in a good gas stove are—1, a smokeless flame; 2, a strong, firm, indestructible frame that will easily support a large or small vessel and is not easily overturned; 3, an easy and quick adjustment, whereby either a strong, well-sustained heat or a low, diffused heat may be obtained. Prof. Parrish devised a pharmaceutical stove which had these qualifications, but it is not made at present. Fig. 68 shows Fletcher's low-temperature gas stove. This stove affords an excellent range of temperature, and is constructed on the same principles as Parrish's gas furnace. For low temperature the gas is turned on and lighted from below, the gas issuing from the numerous orifices in the gas-ring; this does not give here a smokeless flame. When a high heat is desired, the gas is ignited above the

FIG. 68.

Low-temperature gas stove.

FIG. 69.



Water-heater.

gauze at A, and when a smokeless, intensely hot flame is desired, a blast of air may be blown through the pipe C. The chief disadvantage in this stove is one which is common to all of its class, and arises from the use of gauze, which is very likely to become choked with dirt, rust, soot, etc., particularly if from the accidental boiling over of an acid liquid partial corrosion of the gauze takes place.

One of the greatest conveniences that a pharmacist can have at a dis-

pensing counter, where a large supply of hot water cannot be had from a boiler, is the ingenious water-heater shown in Fig. 69. The burner and water-heater may be detached, so that when hot water is not wanted the burner may be used for other purposes. If hot water is desired, the pipe at the top is connected with a hydrant, the water turned on, and the gas-burner lighted below; in a few seconds warm water, and in a minute or two hot water, will run from the lower pipe. Of course the temperature of the water will vary with the rapidity of the flow through the pipe; the water-heater may be permanently attached to the cold-water tap, if desired, and used for cold water regularly, and when hot water is wanted occasionally, the burner may be lighted to supply it.

The advantages of the use of illuminating gas as a source of heat may be summed up as follows: 1. It may be made to furnish a clean, smokeless flame. 2. It is cheap when compared with alcohol and other sources of heat, and is particularly economical in large cities. 3. The supply is unremitting, and the inconvenience of continually supplying fuel, which is always present in other forms of stoves, is not experienced here. 4. The supply is under almost perfect control, and, after once regulating the flow suitable for a continuous operation, little apprehension need be felt, during the operator's enforced absence, of an injurious rise or fall in the temperature.

METHODS OF MEASURING HEAT.

To measure degrees of temperature in pharmaceutical operations thermometers are used exclusively. A thermometer may be described as an instrument consisting of a glass tube having a capillary bore, with a cylindrical or globular bulb blown at the end, the bulb and a part of the stem containing a liquid (usually mercury), and the tube being mounted upon a graduated scale, or the tube itself graduated, in order to measure the degree of expansion of the liquid when subjected to the influence of heat. Unfortunately, the value of the degrees of thermometers in common use is not the same, there being no less than three arbitrary scales,—Centigrade, Fahrenheit, and Réaumur, the latter rarely used.

The *Centigrade*, or Celsius's, scale is best adapted for scientific work; it is given the first place in the U. S. Pharmacopœia, 1880. The freezing-point of water is zero, 0°, and the boiling-point is 100°; the intervening space is divided into one hundred equal parts (see Fig. 70).

The *Fahrenheit* scale is much the most largely used in this country and Great Britain, and until the last revision of the U. S. Pharmacopœia it was used exclusively in pharmacy. The Centigrade degrees in the Pharmacopœia are followed by those of Fahrenheit enclosed in parentheses, as 100° C. (212° F.). In Fahrenheit's thermometer the freezing-point is 32°, and the boiling-point is 212°, the intervening space being divided into one hundred and eighty equal parts (see Fig. 71). In Réaumur's thermometer the freezing-point is 0°, and the boiling-point is 80°.

In Figs. 73, 74, and 75 the three thermometers are shown together to facilitate comparison: the lowest figures indicate the freezing-points of each, the highest the boiling-points.

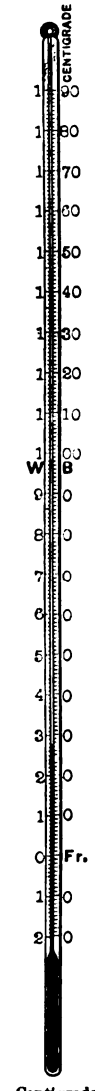
Rules.

1. *To convert Centigrade degrees into those of Fahrenheit* above 32, multiply by 1.8 and add 32.

2. *To convert Fahrenheit degrees above* 32 *into those of Centigrade*, subtract 32 and divide by 1.8.

Choice of Thermometers.—It is important that the practical pharmacist should possess a good thermometer. The best form is one in which the graduations are made on the surface of the tube. The diameter of the instrument should be the same throughout its entire length; this permits its convenient use through perforated corks in distillations and other operations where it is necessary to observe temperature, and it is not so easily broken (see Fig. 71). The thickness of the glass of the bulb is not a matter of indifference: if too thick, the thermometer will not respond quickly to changes of temperature, whilst if too thin, the risk of fracture is very great. The bore of the tube should be flat or elliptical, and perfectly uniform throughout. The absence of air in the tube may be known by the descent of the mercury to the lowest part of the tube when the thermometer is inverted. A strip of opaque, white enamelled glass behind the bore of the tube is of great assistance in reading the indication

FIG. 70.



Centigrade thermometer.

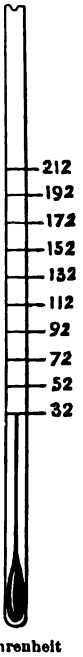
FIG. 71.

Fahrenheit thermometer.

FIG. 72.

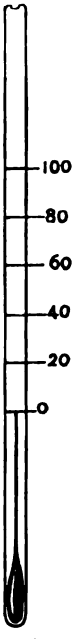
Paper-scale thermometer.

FIG. 73.



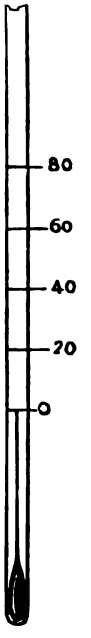
Fahrenheit thermometer.

FIG. 74.



Centigrade thermometer.

FIG. 75.



Réaumur thermometer.

quickly. A cheaper thermometer, which will answer for many purposes, has a paper scale inside of a glass tube (see Fig. 72). These should not be used for temperatures over 300° F., as in time the paper becomes charred. It is a good practice to send a thermometer to be officially tested,[1] and then to reserve it as a standard for correcting ordinary instruments. As glass usually reaches its limit of contraction in three years, such a thermometer should be at least this old before it is sent.

Table of Melting-Points of Officinal Substances.

Acidum Aceticum Glaciale	15° C.	=	59° F.
Sodii Sulphas	30° C.	=	86° F.
Oleum Theobromæ	30°–35° C.	=	86°–95° F.
Adeps	35° C.	=	95° F.
Sodii Carbonas	35° C.	=	95° F.
Acidum Carbolicum (crystals)	36°–42° C.	=	96.8°–107.6° F.
Sodii Phosphas	40° C.	=	104° F.
Petrolatum	40°–51° C.	=	104°–123.8° F.
Phosphorus	44° C.	=	111.2° F.
Sevum	45°–50° C.	=	113°–122° F.
Sodii Hyposulphis	50° C.	=	122° F.
Cetaceum	50° C.	=	122° F.
Thymol	50° C.	=	122° F.
Quinina	57° C.	=	134.6° F.
Chloral	58° C.	=	136.4° F.
Cera Flava	63°–64° C.	=	145.4°–147.2° F.
Camphora Monobromata	65° C.	=	149° F.
Cera Alba	65° C.	=	149° F.
Potassii et Sodii Tartras	75° C.	=	167° F.
Quininæ Valerianas	90° C.	=	194° F.
Alumen	92° C.	=	197.6° F.
Acidum Citricum	100° C.	=	212° F.
Atropina	114° C.	=	237.2° F.
Iodum	114° C.	=	237.2° F.
Sulphur Lotum	115° C.	=	239° F.
Zinci Chloridum	115° C.	=	239° F.
Iodoformum	115° C.	=	239° F.
Piperina	128° C.	=	262.4° F.
Resina	135° C.	=	275° F.
Strychninæ Sulphas	135° C.	=	275° F.
Ammonii Sulphas	140° C.	=	284° F.
Codeina	150° C.	=	302° F.
Chrysarobinum	162° C.	=	323.6° F.
Ammonii Nitras	165°–166° C.	=	329°–330.8° F.
Santoninum	170° C.	=	338° F.
Camphora	175° C.	=	347° F.
Acidum Salicylicum	175° C.	=	347° F.
Acidum Chromicum	190° C.	=	374° F.
Salicinum	198° C.	=	388.4° F.
Aluminii Sulphas	200° C.	=	392° F.
Argenti Nitras	200° C.	=	392° F.
Picrotoxinum	200° C.	=	392° F.
Elaterinum	200° C.	=	392° F.
Cinchoninæ Sulphas	240° C.	=	464° F.
Cinchonina	250° C.	=	482° F.
Hydrargyri Chloridum Corrosivum	265° C.	=	509° F.
Strychnina	312° C.	=	593.6° F.
Sodii Nitras	312° C.	=	593.6° F.
Potassii Nitras	340° C.	=	644° F.
Argenti Iodidum	400° C.	=	752° F.

[1] Thermometers are examined, and certificates are issued showing the corrections, by Winchester Observatory of Yale College, New Haven, Conn.

CHAPTER III.

USES OF HEAT.

THE consideration of the uses of heat in pharmacy will follow naturally the preceding chapter upon its generation and measurement, and the subject may be properly treated of under two classes,—viz.: 1, those operations in which comparatively high temperatures are required, and, 2, those which require moderate or low temperatures. It will be readily noticed that the latter class will embrace nearly all of the more important pharmaceutical operations in which heat is employed.

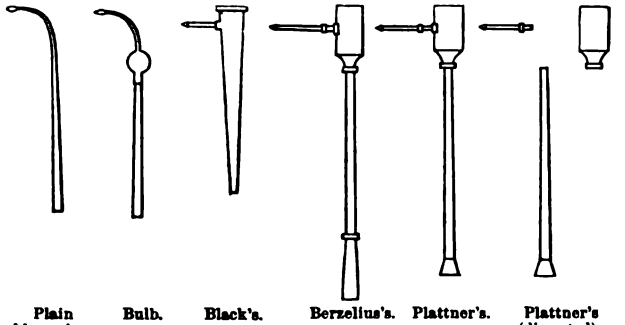
Operations in which comparatively High Temperatures are required.—In this class of operations must be placed some which seem to be in danger of becoming lost arts through the growth of special methods, which are now conducted on a large scale by manufacturers, who supply the products of their skill so cheaply that the home-made apparatus is often produced at a pecuniary loss. It will, nevertheless, be found useful to refer briefly to these operations, for a certain amount of knowledge will frequently be of service to the practical worker in emergencies and on special occasions.

The Use of the Blow-Pipe.—A blow-pipe in its simplest form is a metallic tube, usually of brass or copper, slightly conical, gradually tapering to a minute orifice, the narrowest portion being curved so that the axis of the orifice is at right angles to that of the principal portion of the tube. It is used by placing the widest end in the mouth, and inserting the other end into the edge of the flame, and forcing a current of air through the tube, with the effect of increasing the intensity of the flame by converting it into a miniature blast. Some skill and practice are required to produce an unremitting current of air, and this is effected by keeping the muscles of the cheeks distended and constantly supplying air from the lungs as it is needed. When the blow-pipe is used with a luminous flame, the interior of the flame, owing to the carbon not being wholly oxidized, has the power of deoxidizing or reducing oxides, whilst the outer flame has opposite or oxidizing properties: a piece of lead glass tube held in the inner flame will be blackened through the reduction of the lead oxide to the metallic state; if this stain is held in the outer flame the metal is reoxidized, dissolves in the glass, and the glass again becomes transparent. The blow-pipe is useful in pharmacy in working and bending glass, in testing fusible chemical substances, in soldering apparatus, etc. The various forms of blow-pipes in common use are shown in Figs. 76 to 81.

The Fletcher's gas blow-pipe, shown in Fig. 82, furnishes an excellent and very powerful blast which is capable of delicate adjustment. It

has a universal ball-and-socket joint, which enables it to be used in any position. The very convenient foot-bellows, shown in Fig. 83, may be used in connection with it for producing the blast. The sides of this

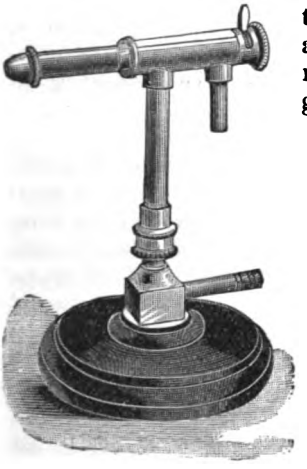
Fig. 76. Fig. 77. Fig. 78. Fig. 79. Fig. 80. Fig. 81.



Plain blow-pipe. Bulb. Black's. Berzelius's. Plattner's. Plattner's (dissected).

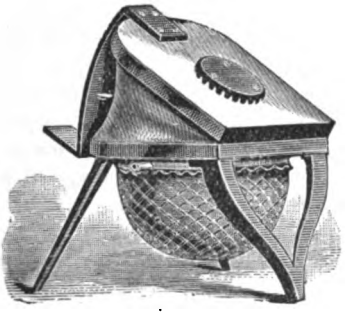
bellows are of stout leather, and the reservoir of air beneath is obtained by stretching and fastening a circular piece of thin rubber cloth over the lower orifice and preventing too great expansion and rupture by enclosing it in a net: this form, with the reservoir below, is preferable to that formerly in use, which had the rubber cloth above; the advantages are greater protection against injury from falling

Fig. 82.



Gas blow-pipe.

Fig. 83.



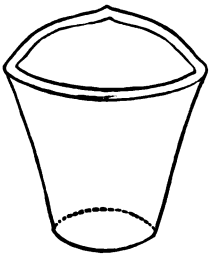
Foot-bellows.

articles, and less obstruction to the valves through sucking in dust from the floor.

Crucible Operations.—A crucible is a cup-shaped vessel made of platinum, silver, black lead, iron, porcelain, wedgwood-ware, or clay, and intended to withstand a very powerful heat. It is used for fusing metals or heating metallic oxides or organic substances, and is very useful in chemical analysis. The Hessian crucible (see Fig. 84) is the cheapest: it is unfitted for delicate operations, for, although capable of withstanding great heat, its porous character permits the ready absorption of many substances. The black-lead crucible is more expen-

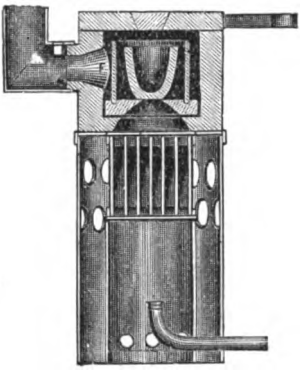
sive: it is less porous, is infusible, and has the great merit of bearing great changes in temperature without risk of fracture. Porcelain or wedgwood crucibles are fragile, and have to be very gradually cooled to prevent breakage. Fletcher's gas crucible furnace (see Fig. 85) is very useful in this connection. Of the metals used in making crucibles,

FIG. 84.



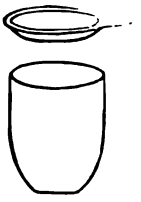
Hessian crucible.

FIG. 85.



Crucible furnace.

FIG. 86.



Platinum crucible.

platinum is superior to any: its well-known power of resisting fusion, its cleanliness, and its non-liability to be acted upon by most chemical substances render it invaluable to the chemist, notwithstanding its costliness (see Fig. 86).

The following processes require the application of high heat:

1. *Ignition*, in the sense in which it is used in the Pharmacopœia and by chemists generally, is the process of strongly heating solid or semi-solid substances, the residue left at the conclusion of the process being the object sought. The officinal quantitative tests for phosphoric acid, phosphate of ammonia, and purified sulphide of antimony afford examples of the use of this process.

2. *Fusion* is the process of liquefying solid bodies by the application of heat without the use of a solvent: the melting of wax, and the preparation of moulded nitrate of silver, are familiar examples of this process.

3. *Calcination* is the process of separating volatile substances from fixed inorganic matter by the application of heat without fusion: its principal application in pharmacy is in the expulsion of water and carbonic acid from carbonates, as shown in the processes for making magnesia, lime, etc.

4. *Deflagration* is the process of heating one inorganic substance with another capable of yielding oxygen (usually a nitrate or a chlorate); decomposition ensues, accompanied by a violent, noisy, or sudden combustion. Deflagration is used in making some of the salts of antimony and arsenic, and in some qualitative analytical examinations.

5. *Carbonization* is the process of heating organic substances *without* exposure to air until the volatile products are driven off, and the residue assumes the black color characteristic of free carbon or charcoal. The manufacture of bone-black and wood charcoal affords good illustrations.

6. *Torrefaction* (known also as roasting) is the process whereby organic substances have some of their constituents modified by the application of a degree of heat somewhat less than that necessary to carbonize them. The most familiar example of this process is the roasting of coffee. Rhubarb in coarse, dry powder, when subjected to this process, loses its cathartic properties, but retains its astringent qualities, and is known as *Torrefied Rhubarb.*

7. *Incineration* is the process of heating strongly, organic substances *with* access of air until all the carbon is consumed, the ashes which remain being the object sought. The process is frequently used in analysis to determine the amount of fixed matter in an organic substance.

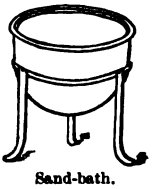
8. *Sublimation* is the process of separating a volatile solid substance from one which is not volatile by the application of heat. A special chapter on this subject will be found in the succeeding pages.

OPERATIONS REQUIRING HEAT IN WHICH LOWER TEMPERATURES ARE USED.

In this class of operations will be found the most important of those requiring the application of heat; almost all medicinal substances have their properties altered by the action of heat, and many cases are met with where it is necessary to moderate carefully the heat in order to prevent the decomposition or destruction of the active agent; for the purpose of controlling heat various baths are used, as the sand-bath, oil-bath, solution-bath, steam-bath, water-bath, etc.

The sand-bath is usually an iron vessel of hemispherical or other convenient shape, containing dry, clean sand (see Fig. 87); the vessel to be heated is embedded in the sand, and the bath is then heated to the required degree. The object of this form of bath is to equalize the temperature, and to prevent a too sudden rise or fall of heat whereby unequal expansion or contraction might cause fracture to a glass or porcelain vessel being heated. Iron-wire clippings have sometimes been substituted for sand, with doubtful advantage, however.

FIG. 87.



Sand-bath.

The practical error usually made by inexperienced operators in the use of the sand-bath is in permitting too large a body of sand to rest between the bottom of the vessel to be heated and the flame; this results in an unnecessary waste of heat.

The oil-bath is designed to furnish a regulated temperature below 260° C. (500° F.). A fixed oil is the medium usually employed for communicating the heat, but one of the best substitutes for oil is petrolatum. Most fixed oils, when heated above 177° C. (350° F.), evolve disagreeable fumes.

In fractional distillation on a large scale, oil-baths are often used to control temperature, and the fumes arising from the heated oil are carried off by a pipe to the chimney.

The glycerin-bath.—In order to avoid the disagreeable odors arising from hot oil, glycerin is sometimes substituted. Acrolein, an acrid, volatile product, however, is produced if glycerin is heated nearly to

boiling. A temperature of 250° C. (482° F.) can be maintained in a glycerin-bath without much inconvenience.

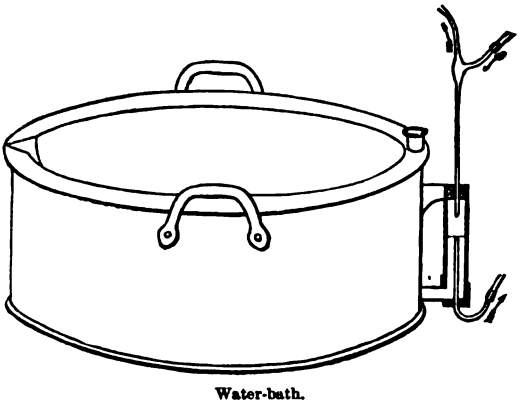
Salt-water baths are sometimes used in special operations; their principle of action depends on the fact that the boiling-point of a liquid is raised in proportion to the quantity of fixed salt dissolved in it. Water, as is well known, boils at 100° C. (212° F.), but if common salt is dissolved in water until it ceases to take up any more, and a saturated solution is produced, it is found that this solution does not boil until the temperature of 108.4° C. (227.1° F.) is reached. The following table shows the boiling-point of certain saturated solutions as determined by Legrand and others:

Table of Boiling-Points of Saturated Solutions of various Salts.

Salt.	Boiling-Point.		Salt.	Boiling-Point.	
	C.	F.		C.	F.
Chloride of Sodium . . .	108.4°	227.1°	Acetate of Sodium	124.4°	256°
Chloride of Ammonium . .	114.2°	237.6°	Carbonate of Potassium . .	135°	275°
Tartrate of Potassium . .	114.7°	238.5°	Nitrate of Calcium	151°	303.8°
Nitrate of Potassium . . .	115.9°	240.2°	Acetate of Potassium . . .	169°	336.2°
Nitrate of Sodium	121°	249.8°	Chloride of Calcium . . .	179°	354.2°

The water-bath is one of the most useful of all the forms of pharmaceutical apparatus for regulating temperature, and the frequency with which it is directed to be used in works of authority indicates its importance as a necessary implement in the equipment of every pharmaceutical laboratory. Almost all the water-baths used by pharmacists are extemporized, and these are generally crude and inconvenient; two dishes usually suffice, one of them somewhat larger in diameter than the other. Water is poured into the larger dish, and the other dish, containing the liquid to be heated, is placed in the water and the heat applied; the room is soon filled with the escaping steam, and in winter the condensation of the moisture upon the windows is alone a sufficient inconvenience to render it undesirable. Fig. 88 shows a tinned copper water-bath in which this annoyance is overcome. The water-level has at its lowest point a piece of block-tin tube soldered in; this extends half-way up the glass tube in the inside, whilst a perforated cork at the upper end of the glass tube permits the insertion of another piece of block-tin tube; the upper

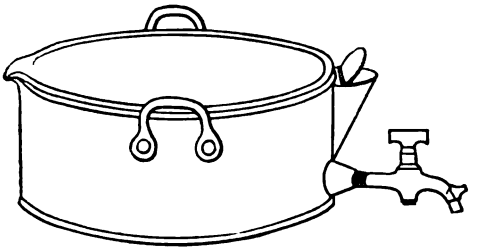
Fig. 88.



Water-bath.

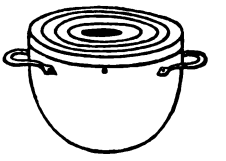
tube connects with the cold-water faucet and terminates in the smoke-flue or with the outside air; the vapor arising from the boiling water either passes off into the chimney, as shown by the arrow, or is condensed, the loss being supplied by a small stream of water from the cold-water faucet, shown by the arrow pointing downward; the lower block-tin tube acts as an overflow, the excess of water being carried off by a rubber tube into the sink; all possibility of the water-bath "boiling dry" is thus obviated. Vapors from the liquid in the water-bath may be carried off by a hood (see Fig. 123). A simple water-bath may be made by encasing a tinned-copper round-bottomed dish in one of larger diameter having a flat bottom. Water is poured in through a tubulure in the top, and it is replenished as required. Fig. 89 shows a similar water-bath, a porcelain evaporating dish taking the place of the copper one. It is useful where a metallic dish would be acted on by the substance to be

FIG. 89.



Water-bath (porcelain dish).

FIG. 90.



Water-bath (copper ring).

heated. A water-bath intended for the smaller operations of analytical chemistry is shown in Fig. 90. The different sizes of the rings render it convenient for vessels of various shapes and sizes. It will be necessary to allude frequently hereafter to the uses and modifications of the water-bath.

THE USE OF STEAM IN PHARMACEUTICAL OPERATIONS.

The scope of this work will not permit of any extended consideration of the use of steam in technical pharmacy, yet it is of vital interest to be acquainted not only with the theories underlying its employment, but also with the apparatus used in its practical application.

When water is heated to the boiling-point and steam is produced, a certain amount of heat is absorbed (or apparently lost): this has been termed *latent heat.* When steam comes in contact with surfaces having less heat than itself, it is condensed, water is produced, and the latent heat becomes *sensible* (or reappears), thus proving the well-established physical law that *when a liquid assumes the gaseous state, a certain fixed and definite amount of heat disappears; and, conversely, when a gas or vapor becomes a liquid, heat to a corresponding extent is evolved.* Watts has illustrated this as follows: "When water at 0° C. is mixed with an equal weight of water at 100° C., the whole is found to have the mean of the two temperatures, or 50° C. On the other hand, 1 part by weight of *steam* at 100° C., when condensed in cold water, is found to be capable of raising 5.4 parts of the latter from the freezing-point to the boiling-

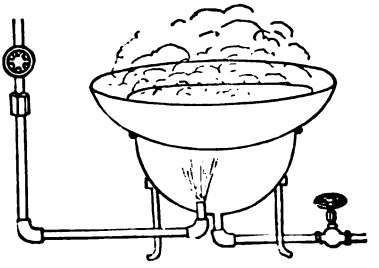
point, or through a range of 100° C. Now, $100 \times 5.4 = 540$; that is to say, steam at 100° C. in becoming water at 100° C. parts with enough heat to raise a weight of water equal to its own (if it were possible) 540° of the Centigrade thermometer, or 540 times its own weight of water one degree of the same." When water passes into steam the same quantity of sensible heat becomes latent. A consideration of these facts in physics leads to the practical application of steam as a transmitter of heat, whereby heat from any source may be absorbed by steam and carried through suitable pipes to the vessel designed to be heated. If this vessel is filled with a cold liquid, the latent heat of the steam is rapidly communicated to the liquid, the steam is condensed, and the result is this most convenient and economical method of producing a temperature which is capable of being regulated with great exactness.

Steam-baths may be divided into two classes: 1, those in which steam is used without pressure; and, 2, those in which steam is used under pressure.

1. *The use of Steam without Pressure.*—In many cases open steam, as it is termed, is used (see Fig. 91). The pipe which conveys the steam from the boiler is conducted to the bottom of a hemispherical kettle, and the liquid to be heated is poured into a dish of larger diameter, which is placed upon the top; the steam is turned on, and as it condenses is carried off by the drip-pipe. A temperature of about 100° C. (212° F.) can usually be maintained by this method.

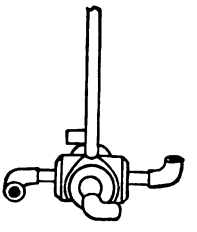
Sometimes the steam-pipe is conducted directly from the top into the liquid to be heated. A steam-distributor, as shown in Fig. 92, may be used at the end of the pipe near the bottom of the kettle; it is made by screwing a cross upon the end of the pipe, and an elbow to each arm

FIG. 91.



Open steam-bath.

FIG. 92.



Steam-distributor.

of the cross; the steam issues usually with some force from each elbow and effectually stirs up the liquid, and rapidly produces a uniform temperature in it. The principal disadvantages about using steam in this way are the noise at first produced by the contact of the hot steam with the cold liquid, and the increase in bulk of the liquid through the condensation of the steam.

2. *The use of Steam under Pressure.*—This is by far the most convenient method of using steam practically as a means of transmitting heat. It has been stated that steam produced in open and unconfined vessels, with the ordinary pressure of the atmosphere, has the temper-

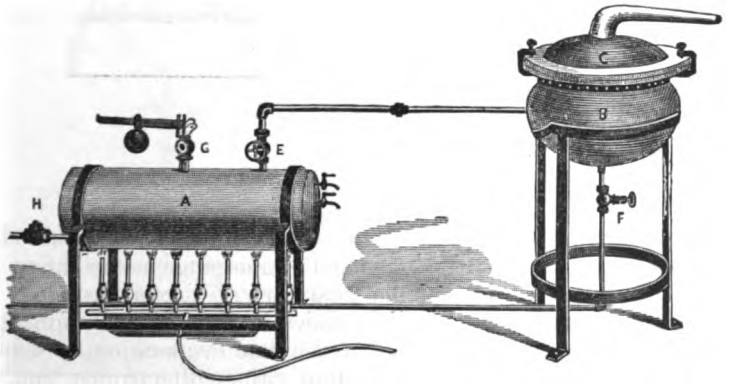
ature of 100° C. (212° F.). If water is heated continuously in a boiler capable of withstanding pressure, the water is prevented from boiling by the pressure of its own vapor, and the temperature of the steam rises in proportion as the pressure increases. It is usually stated that the pressure of the atmosphere is 14.7 pounds to the square inch. The following table shows the increase in temperature of steam when the pressure exceeds that of the atmosphere. Of course the opposite effect is produced when the pressure is removed, and the water boils below the temperature of 100° C. (212° F.). (See vacuum apparatus.)

Table of the Temperatures of Superheated Steam.

Pressure.	Temperature of Steam.		Pressure.	Temperature of Steam.	
Pounds per Square Inch.	C.	F.	Pounds per Square Inch.	C.	F.
14.7	100°	212°	55	141.6°	287.1°
17	104.2°	219.6°	60	144.7°	292.7°
20	108.8°	228°	65	147.7°	298°
23	113°	235.5°	70	150.5°	302.9°
25	115.6°	240.1°	75	153°	307.5°
30	121.3°	250.4°	80	155.5°	312°
35	126.2°	259.3°	85	157.8°	316.1°
40	130.7°	267.3°	90	160°	320.2°
45	134.6°	274.4°	95	162.2°	324.1°
50	138.3°	281°	100	164.4°	327.9°

The principle of the use of steam under pressure is shown in the apparatus (see Fig. 93). It was designed by the author in 1872 to illustrate the subject practically upon the lecture-table. A cylindrical copper boiler, A, supported by a stout iron stand, is heated by a row of six

Fig. 93.



Use of steam under pressure.

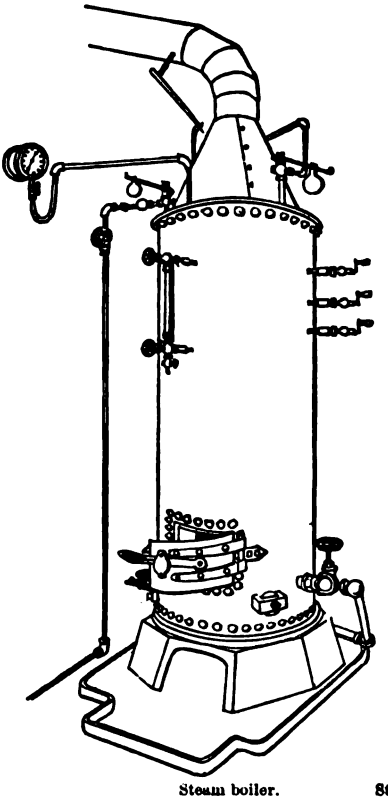
Bunsen burners; water is forced into the boiler from the hydrant through a rubber hose attached to the pipe connected with the check-valve, H. The steam passes into the jacketed kettle, B, and is controlled by the

steam-valve, E, the exhaust steam and condensed water passing through the pipe controlled by the valve F.

An upright tubular steam boiler, suited to operations in the pharmaceutical laboratory, and a sectional view of the same, are shown in Figs. 94 and 95.

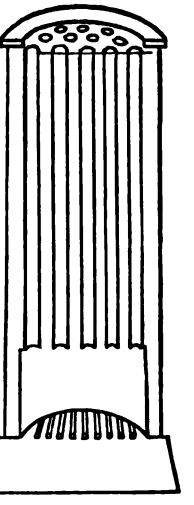
Prof. Patch has contrived a very convenient upright tubular steel boiler, shown in Fig. 96. It is covered with asbestos composition, which acts as a non-conductor of heat, and the source of heat is a large coal-oil

FIG. 94.



Steam boiler.

FIG. 95.



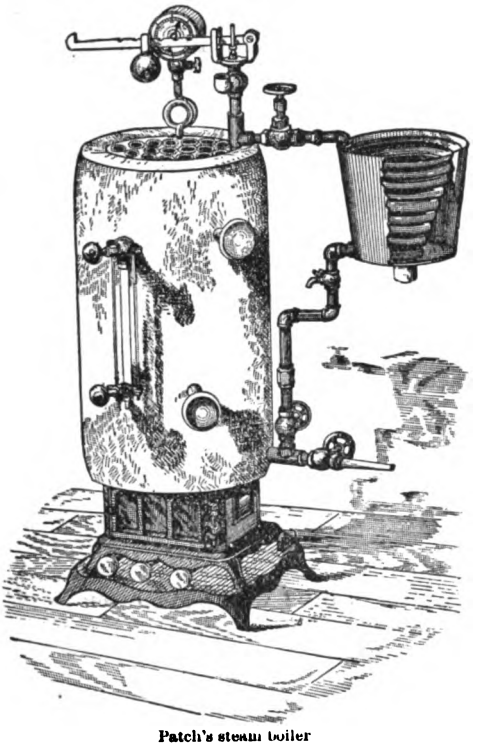
Steam boiler (sectional view).

stove; a conical coil of pipe serves to support a funnel when hot filtration is needed, whilst a safety-valve and steam-gauge assure safety. It is, of course, intended only for the laboratory of a retail druggist.

The usual form of steam kettle is shown in Fig. 97. A copper pan, tinned inside, having flaring sides to facilitate evaporation, is securely connected about midway from the bottom with another copper pan, both being riveted together. An opening for the steam-pipe is made in the jacketed side to admit steam, and at the lowest point of the bottom another pipe is attached to carry off the water which is produced by the condensation of the steam. The upper edge of the kettle is protected by a flat brass ring, which is soldered and riveted to it, and which also

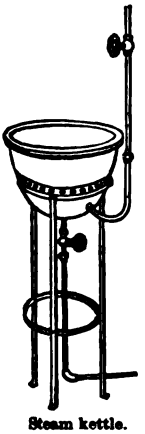
serves to support the still-top when the steam kettle is used for distillations. (See chapter on distillation.) Care should be exercised to have the bottom of the kettle made of copper heavy enough to resist the greatest amount of steam-pressure that will be likely to be used on it, as instances have been known of collapse when this was neglected. In using the steam kettle, the liquid that is to be heated is run into it by a syphon or other means; the drip- or exhaust-cock below is opened partially, and the steam slowly turned on. The habit of opening steam-valves cautiously is one that should be sedulously cultivated, as accidents and strains to steam apparatus often arise from the sudden shocks due to want of care in this respect. While the liquid is becoming heated, the condensed water should be allowed to escape freely, and when the proper temperature is reached, the steam-valve should be carefully adjusted and the exhaust-valve turned so that, whilst all the condensed water may escape, no steam shall

FIG. 96.



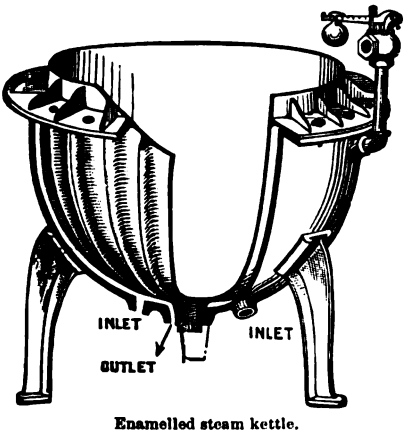
Patch's steam boiler

FIG. 97.



Steam kettle.

FIG. 98.

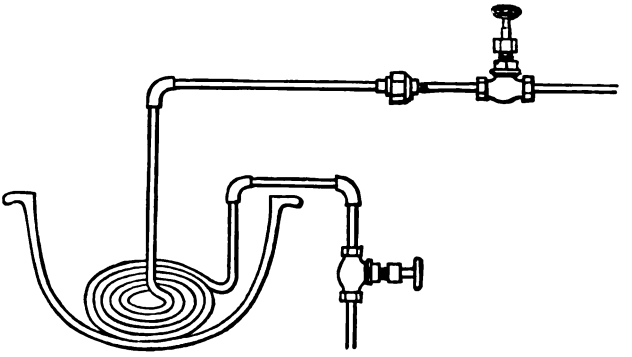


Enamelled steam kettle.

be allowed to go to waste by its being opened too widely. One of the

greatest objections to the use of tinned-copper kettles is that the coating of tin soon wears off, and contamination of the extract or liquid with copper is almost sure to result. The enamelled cast-iron kettle made by Barrows, Savery & Co., of Philadelphia, shown in Fig. 98, is to be preferred on this account, although the injurious cracking of the enamel from overheating and the resulting exposure of the liquid to the iron surface beneath is an objection. It is proper to state that with care the

FIG. 100.

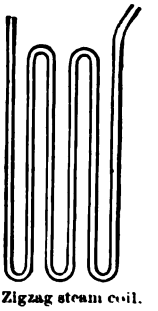


Steam coil.

enamel may often be retained for years in perfect condition. Jacketed iron tanks lined with sheet block-tin are very useful and durable, but their costliness is apt to prevent their extended use.

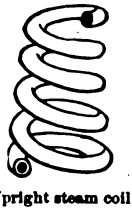
Pressure steam is frequently passed through coils of iron, block-tin, or lead which have been immersed in the liquid to be heated. Fig. 100 shows the usual form. It will be found very useful to the practical worker to use block-tin pipe. Steam-valves may be soldered to both ends of the pipe, and on account of the flexibility of the pipe it may be readily adjusted and coiled to suit available space, whilst the absence of danger from contamination when used for heating most medicinal liquids is an advantage which should not be overlooked. Steam, when

FIG. 104.



Zigzag steam coil.

FIG. 102.



Upright steam coil.

FIG. 103.

Horizontal steam coil.

passed through coils of various shapes, zigzag pipes, etc., is also largely used in heating liquids in special operations, in drying drugs, chemicals, etc. Figs. 102, 103, and 104 illustrate these forms. (See also chapter on desiccation.)

CHAPTER IV.

VAPORIZATION.

UNDER this head will be included those pharmaceutical operations in which volatile substances are separated from fixed bodies, or from others which are less volatile, by the action of heat at varying temperatures. Vaporization is frequently employed in pharmacy, and it will be most convenient to consider its applications in the order of their importance: 1. To Liquids. 2. To Solids.

1. When vaporization is used to separate a *volatile liquid* from a *less volatile* liquid, it is called *evaporation.*

2. When the object sought is the *volatile liquid,* it is called *distillation.*

3. When it is used to separate a *volatile liquid* from a *solid,* it is called *desiccation, exsiccation,* or *granulation.*

4. When it is used to separate a *volatile solid* from another body, it is called *sublimation.*

The following diagram may serve to impress the definitions on the memory:

Vaporization.

Object Sought.	Process.
Liquids:	
Fixed or less volatile	Evaporation.
Volatile	Distillation.
Solids:	
Fixed	Desiccation. / Exsiccation. / Granulation.
Volatile	Sublimation.

The subjects of Evaporation, Distillation, Sublimation, and Desiccation will be considered in the chapters which immediately follow. Vaporization, as applied to Granulation and Exsiccation, will be more appropriately considered after the chapters on Solution and Crystallization.

EVAPORATION.

Although this term has in its more popular sense the signification of the separation of moisture from any body, whether solid or liquid, in pharmacy the word has a more restricted meaning, and signifies the driving off of the more volatile or less valuable portions of a liquid by the application of heat, with the object of purifying it or obtaining the less volatile portion. Illustrations are found in the concentration of syrups and liquids intended for crystallization, and in the treatment of weak tinctures in making fluid-extracts and extracts.

As *ebullition*, or *boiling*, is an important form of evaporation, it will be necessary first to consider the essential points concerned therein. Ebullition in a heated liquid is caused by the formation of bubbles of vapor upon the surface of the vessel, which, rising to the surface of the liquid and bursting, permit the vapor to become diffused in the space above the boiling liquid. The *boiling-point* of a liquid may be defined as the temperature at which the tension of its vapor is equal to the pressure of the atmosphere, this point being *definite*, whilst *evaporation* takes place in the same liquid at nearly all degrees of heat, and hence the *evaporating* point is an *indefinite* temperature. The point at which a liquid boils varies with the liquid, and in the U. S. Pharmacopœia and other authoritative works the boiling-point is frequently considered an important test in establishing the identity or purity of a liquid. The table at the end of this chapter shows the boiling-point of the officinal liquids arranged in order, beginning with the lowest.

FIG. 105.

Boiling-point test.

The boiling-point of a liquid is affected by the cohesion of the liquid and the degree of pressure upon its surface. Water under the ordinary pressure of the atmosphere boils at 100° C. (212° F.). When confined in a steam boiler it has been shown that water can have a temperature considerably over 200° C. (392° F.) without boiling, the bubbles being prevented from rising to the top on account of the pressure of the steam in the confined space above the liquid. On the other hand, the removal of pressure causes a liquid to boil below its normal boiling-point, as will be explained in the chapter on vacuum apparatus. The character of the vessel in which a liquid is boiled has also a slight effect in modifying the boiling-point. (See Evaporation by Boiling.)

Determination of Boiling-Points.—One of the simplest methods of ascertaining the boiling-point of a liquid is illustrated in the cut (see Fig. 105). The liquid is introduced into a test-tube, and a glass tube is selected of such diameter as will permit a tube-thermometer to pass easily through it and leave a small space between; the tube should be about one inch shorter than the thermometer. A short piece of wire should be passed through the glass ring of the thermometer, and slightly bent to hold it in position; a perforated cork should now be fitted tightly to the test-tube, and the tube carrying the thermometer-tube pushed through the perforation in the cork until the bulb of the thermometer is just above the liquid; heat should be applied cautiously by a sand-bath or water-bath. The vapor from the boiling liquid passes upward through the whole length of the thermometer, escaping at the top, and thus the error common to some methods, due to the difference in temperature between the portion of the thermometer in the test-tube and that outside of the test-tube, is measurably avoided.

Tension of Vapors.—If a glass tube, thirty-six inches long, closed at one end, is filled with mercury, and the open end, after closing it

with the finger, carefully inverted in a beaker containing mercury, it will be found that the mercury will run out from the tube into the beaker until a column of mercury about thirty inches in height is left: this column is sustained by the pressure of the atmosphere, and is, in fact, the well-known mercurial barometer-tube: the six inches of space in the tube above the level of the mercury is of course empty, or vacuous. Now, if a few drops of water are passed into the tube by a dropper, they immediately rise to the level of the mercury in the tube, and, although the temperature has not been increased, a portion of the water is vaporized, and the column of mercury is proportionately depressed: this depression is due to the elasticity or tension of the aqueous vapor. If the tube be forcibly pushed down into the mercury, the increased pressure will be found to have liquefied the vapor, and the original quantity of water is recovered; but the depression in the column of mercury may be increased by heat, and when a sufficient amount of heat has been applied to the tube to expel the mercury until none is left in the tube, it will be found that the temperature marks 100° C. (212° F.), which is exactly the boiling-point of the liquid (water), showing that this point must be reached in order to overcome the pressure of the atmosphere. If alcohol or ether be substituted for water, it will be found that the mercury will be depressed in a far greater ratio,—this being due to the greater volatility and lower boiling-point of these liquids. The *maximum density* of the vapor of a volatile liquid in a confined space in contact with the corresponding liquid is reached when its elastic force attains the limit beyond which pressure produces the liquefaction of the vapor. When this limit is reached, the vapor is said to be *saturated:* maximum density varies with the temperature. If a saturated vapor in an enclosed tube is not in contact with an excess of liquid, increase of temperature lowers its density or expands it. On the other hand, when a saturated vapor is cooled, liquefaction gradually takes place, the vapor above the liquid remaining in the condition of maximum density until converted into the liquid: so that *cold* and *pressure* have the effect of *converting vapors into liquids*, whilst *heat* and the *removal of pressure* have the reverse effect,—*i.e.*, the *conversion of liquids into vapors.* The phenomena above described characterize evaporation into a space filled with air as well as evaporation into a vacuum, the only difference being that more time is required to produce the same effects when evaporating in contact with air, for volatile liquids are instantly converted into vapor in a vacuum, while the presence of air retards, but does not prevent, vaporization. A consideration of the foregoing facts leads to the following deductions:

1. The quantity of vapor that will form in a confined space depends upon the amount of pressure and heat to which the liquid is subjected; and when the point of maximum density of the vapor is reached, evaporation ceases if the pressure and temperature remain the same.

2. The rapidity of evaporation of an aqueous liquid in the open air is influenced by the condition of the aqueous vapor always present in the air. If it has the greatest density possible for the degree of heat, evaporation is retarded; but if the aqueous vapor in the atmosphere

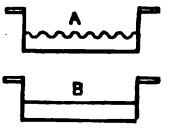
is much below the state of maximum density, as is usually the case, evaporation is promoted.

3. Rapidity of evaporation is increased by removing the pressure of the atmosphere.

4. Increase of temperature obviously accelerates evaporation, by increasing the formation of vapor.

Evaporation of Liquids by Boiling.—In evaporating *by boiling*, temperature, pressure, etc., being equal, the rapidity of the process depends upon the *extent of surface exposed to the heat.* Fig. 106 represents a profile view of two evaporators, A and B. The corrugated bottom of A gives twice as much surface as the smooth bottom of B, and hence if the same quantity of a liquid is made to boil in each, at the same temperature, the bubbles of vapor given off from the corrugated bottom will be twice as numerous as those formed on the plain bottom. The superiority of tubular boilers over the ordinary plain or Cornish boiler also affords a good illustration of this fact (see Fig. 95).

FIG. 106.



Evaporation by boiling.

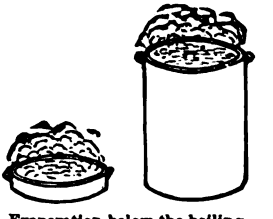
When a pure, volatile liquid is heated to the boiling-point in the open air, its temperature remains the same until the whole of the liquid has evaporated. If, on the other hand, solid matter is dissolved in the liquid, the temperature of the solution is gradually increased until saturation is reached: this fact is well illustrated by considering boiling-points of saturated solutions of various salts (see page 100), and it shows the importance of diminishing the heat in the evaporation of solutions of organic substances as evaporation progresses, as, for example, in the making of extracts, etc.

The cohesion of a liquid affects its boiling-point, dense, thick, and sticky liquids offering more resistance to the escape of the bubbles of vapor than rare, mobile, or thin liquids.

The relative depth of liquid also influences the boiling-point. Shallow vessels favor ebullition, because they afford proportionally less weight of liquid above the bottom of the dish for the bubbles to escape through than deep ones. Rough metallic surfaces favor evaporation by boiling, and are better than smooth surfaces, because they expose a greater amount of surface to the source of heat.

Evaporation below the Boiling-Point.—In evaporating liquids *below their boiling-point*, temperature, pressure, etc., being equal, rapidity of evaporation depends upon the *extent of surface exposed to the air.* Figs. 107 and 108 show two vessels of exactly the same diameter, but of different capacity, containing water: both expose the same amount of surface to the air, but that of Fig. 108 contains eight times more liquid than that of Fig. 107.

FIG. 107. FIG. 108.



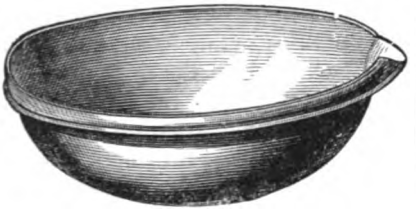
Evaporation below the boiling-point.

If both be subjected to the same temperature, *provided it be below* 100° C. (212° F.), the water will evaporate as rapidly from one as from the other.

Proper Shape of Vessels for Evaporating Liquids.—Broad,

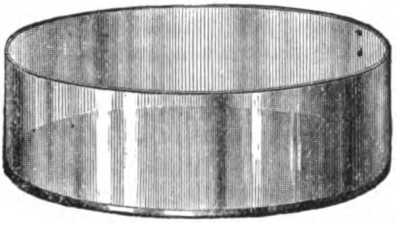
shallow vessels should be used for evaporating below the boiling-point, because the extent of surface is proportionally greater in vessels of this shape. Fig. 109 is an illustration of a porcelain evaporating dish having

Fig. 109.



Porcelain evaporating dish.

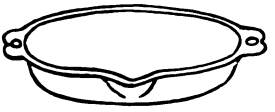
Fig. 110.



Glass evaporating dish.

the proper shape: the chief objection to dishes of this kind is their liability to breakage. Care should be taken to dry the bottom of the dish thoroughly before placing it over a gas-flame. A glass evaporating dish is shown in Fig. 110. This should always be used in a sand-bath, or should be otherwise protected from direct heat. Enamelled cast-iron dishes are very useful, notwithstanding the lack of durability of the enamel. Enamelled sheet-iron dishes, called "agate-ware," are very light, and are much more lasting than the ordinary enamelled cast-iron dishes (see Fig. 111).

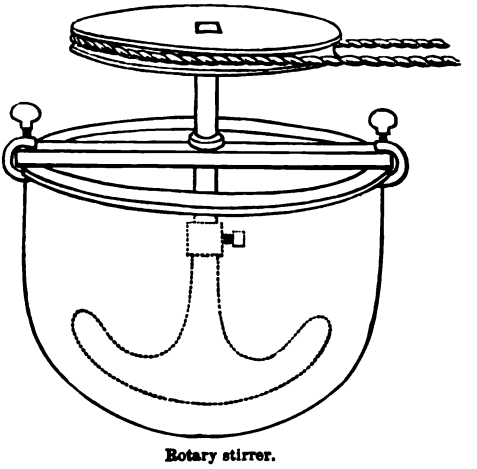
Fig. 111.



"Agate-ware" evaporating dish.

Use of Stirrers.—By stirring an evaporating liquid the surface is largely increased, whilst the currents of air produced at the same time greatly assist in dissipating the vapors which rise. Upon the small

Fig. 115.



Rotary stirrer.

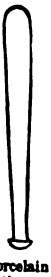
Fig. 113.

Porcelain stirrer (double).

Fig. 114.

Horn stirrer.

Fig. 112.



Porcelain stirrer.

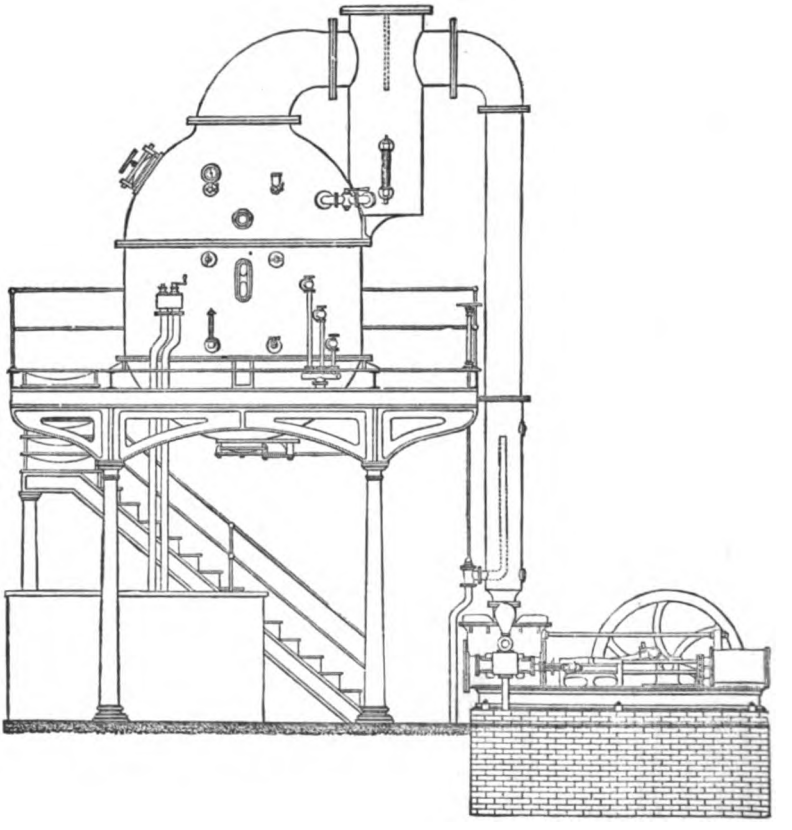
scale, porcelain, horn, or wooden stirrers are used (see Figs. 112, 113, and 114), whilst mechanical stirrers are usually employed in the labo-

ratory in more extensive operations. Fig. 115 shows a rotary stirrer to be operated by steam-power.

Vacuum Apparatus.—It has already been shown (page 108) that the boiling-point of liquids is lowered by removing the pressure of the atmosphere. This fact is easily proved by placing under the receiver of an air-pump some alcohol in a test-glass containing a few pieces of broken glass; when, upon exhausting the receiver, many bubbles of vapor will rise from the surface, and the liquid will boil at the ordinary temperature. Water will boil at 84° C. (183.2° F.) upon the top of Mont Blanc, on account of the diminished pressure of the atmosphere.

The practical application of these principles is of great importance in pharmacy, and vacuum-pans are frequently used in the larger laboratories

FIG. 116.



Vacuum apparatus.

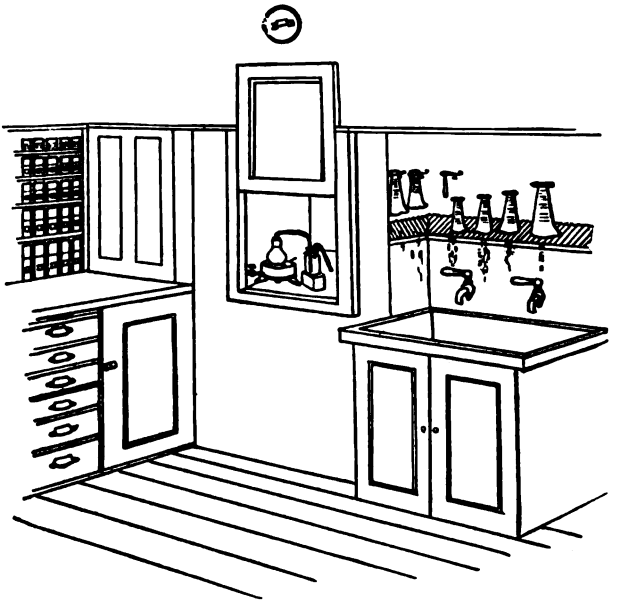
for concentrating solutions which are injured by heat under the ordinary pressure of the atmosphere, and especially in evaporating solutions of organic substances, for these are almost without exception injured by heat.

In Fig. 116 a vacuum-pan, made by Lafferty, Gloucester, N. J., is

shown. The top of the pan or kettle is furnished with a very wide pipe, which is bent twice, and connected at its lower extremity with a steam-pump. Steam-pipes are attached to the bottom of the vacuum-pan so that a moderate heat may be used if necessary. The air is exhausted from the pan upon starting the pump, and the vapor from the evaporating liquid may be condensed or wasted as desired. The pan is furnished with thermometers, gauges, windows, etc., so that the evaporation is under complete control.

It frequently happens that the pharmacist is unable to devote much space to laboratory operations: this is particularly the case in cities or large towns, where rents are high. When pharmaceutical operations must be conducted in the store, an absolutely indispensable convenience is an *evaporating chamber* (see Fig. 117). If the arrangement of the store will admit of it, this should be built into a chimney-breast. The

FIG. 117.



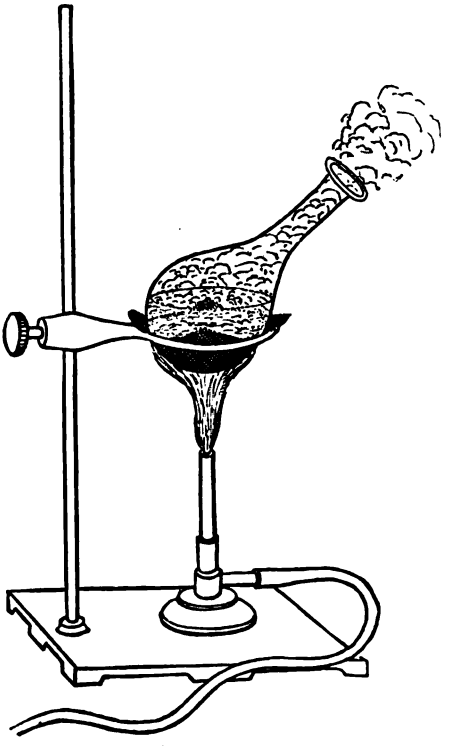
Evaporating chamber.

bottom of the chamber is preferably made of a slate slab, which should have a slight inclination towards the front, and be large enough to project about two inches over the closet upon which it rests, for the purpose of preventing a liquid, spilled by accident, from running into the closet and soiling the contents. The chamber should have a gas-pipe in it, and the upper part should connect, by a flue in which there is a damper, with a chimney having a good draught. A wooden or galvanized-iron front having a light of glass fitting tightly in it will prevent vapors or odors from getting into the store, while operations

can be seen and go on with occasional attention. The space below may be utilized as a closet for evaporating dishes, gas stoves, etc.

Evaporation by Direct Heat.—This method usually requires the greatest amount of care in order to avoid loss or injury by overheating: it is to be preferred, therefore, only in cases where the residue is not easily injured by such an accident. The evaporation of saline solutions in crystallization, or of weak aqueous organic solutions, may usually be performed by the application of direct heat. Careful watching, however, is necessary, and also frequent stirring, to prevent the formation of a crust upon the bottom. Fig. 118 shows a method of evaporating by direct heat by using a flask supported on a piece of brass-wire gauze, upon a retort stand.

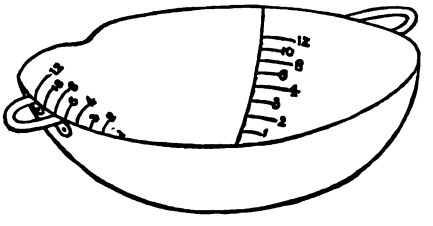
FIG. 118.



Flask evaporation.

Evaporation to a Fixed Volume.—This operation cannot be performed accurately without inconvenience, and hence it is much more satisfactory to evaporate a liquid to a definite weight,—all that is necessary in the latter case being to use a tared dish, and weigh the dish and contents when evaporation has progressed to the desired point. In evaporation to a definite measure, a graduated evaporating dish (see Fig. 119) may be employed, care being taken to level it by noticing that the height of the liquid is the same on each side, or the expedient illustrated in Fig. 120 may be resorted to. An ordinary evaporating dish, D, is placed upon a grommet, G (see page 116), and subjected to the heat (in this case the temperature is intended to be that of a warm room); a perforated wooden strip, A, is placed across the dish, and a glass thermometer, T, is supported in an upright position in the liquid by a perforated cork. Sufficient water is poured into the dish to equal the final measure of the liquid, and a small rubber band is slipped on the

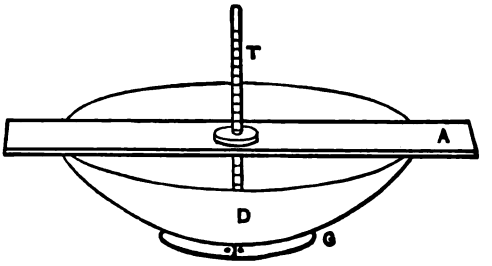
FIG. 119.



Graduated evaporating dish.

thermometer (or a piece of string tied on) to indicate the desired level of the liquid; the water is replaced by the liquid to be evaporated, and evaporation proceeded with until the liquid has been lowered to the mark on the thermometer. When the use of a thermometer is unnecessary, a notched stick may be substituted. In order to arrive at results approaching accuracy by these methods, the liquid must be allowed to cool to the temperature of the water which was used as the measure of the liquid in the beginning.

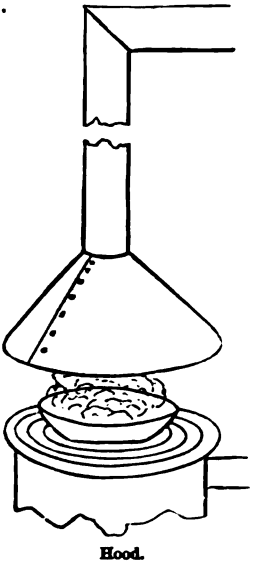
Fig. 120.



Measuring evaporation.

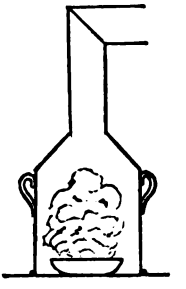
Use of Hoods.—A hood is a contrivance, usually of a conical shape, intended to collect and dispose of vapors which, from their disagreeable odors or their suffocating effects, render the atmosphere of the store or laboratory unwholesome. Fig. 121 shows a form of hood which has been found useful upon the small scale: it is made of galvanized iron, and connects by galvanized stove-pipe with the strong draught of a good chimney; the stove-pipe running horizontally to the chimney should have a damper in it. If any condensation of the vapors takes place in the stove-pipe, the larger diameter of the circular hood will cause the drops of liquid to fall outside of the evaporating dish, and thus contamination of the contents of the dish is avoided. Hoods are usually made of wood when intended for operations upon the large scale. Fig. 122 illustrates the method of using a hood when the dish is placed upon a stove.

Fig. 121.



Hood.

Fig. 122.



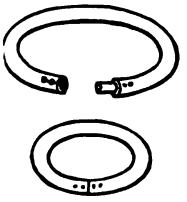
Stove hood.

Use of Grommets.—One of the inconveniences in using round-bottomed evaporating dishes is due to the shape of the bottom, serious loss often occurring from the tilting of the dish and spilling of the contents: to obviate this, *grommets* should be used. These may be economically made from a cast-off piece of rubber hose or tubing by bending it into a circle, placing a wooden plug in one end, tacking it securely, and inserting it in the other end and fastening it in the same manner (see Fig. 123): an elastic ring is thus formed, upon which an evaporating dish or round-bottomed vessel may be safely placed. Grommets serve another very important purpose, that of preventing the fracture of a porcelain or

glass dish containing a hot liquid, by being placed between the hot dish and the cold surface of a table or floor.

Spontaneous Evaporation.—By this term is meant the evaporation of a liquid at the ordinary temperature of the atmosphere, or without the application of strong, direct heat. It is used in cases where the residue or less volatile liquid is liable to injury or loss by the application of much heat, or in crystallization, where, by the slow vaporization of the volatile liquid, finely-formed crystals may be secured, and in other less important operations. Spontaneous evaporation is usually conducted in drying-rooms or closets when they are accessible; these, as will be subsequently described, are rooms or closets which are very slightly heated by the use of exhaust steam or other means; or this form of evaporation may be used by placing the liquid in shallow dishes or trays and exposing the surface to the rays of the sun during fine weather. Upon the small scale, one of the most convenient methods is to support the dish upon a wire tripod placed upon a stove, at a sufficient distance above the top of the stove to avoid injury, or if heated air from a furnace is available, it can be utilized by supporting the dish, properly protected, over the register; the upward current of dry heated air greatly assists in promoting the evaporation. It is well to cover the dish loosely with coarse muslin or paper, to prevent dust and particles of dirt from dropping into the dish.

FIG. 128.



Grommets.

Table of Boiling-Points of Officinal Substances.

Æther Fortior	37° C.	=	98.6° F.
Carbonei Bisulphidum	46° C.	=	114.8° F.
Benzinum	50°–60° C.	=	122°–140° F.
Chloroformum Purificatum	60°–61° C.	=	140°–141.8° F.
Spiritus Ætheris Nitrosi	63° C.	=	145.4° F.
Bromum	63° C.	=	145.4° F.
Æther Aceticus	76° C.	=	168.8° F.
Alcohol	78° C.	=	172.4° F.
Chloral	95° C.	=	203° F.
Amyl Nitris	96° C.	=	204.8° F.
Aqua	100° C.	=	212° F.
Oleum Sinapis Volatile	148° C.	=	298.4° F.
Acidum Carbolicum	181°–186° C.	=	357.8°–366.8° F.
Creasotum	200° C.	=	392° F.
Camphora	205° C.	=	401° F.
Thymol	230° C.	=	446° F.
Camphora Monobromata	274° C.	=	525.2° F.
Glycerinum	290° C.	=	554° F.
Hydrargyrum	350° C.	=	662° F.

CHAPTER V.

DISTILLATION.

THE first part of the process of *distillation* is identical with that of evaporation, for it is simply the *vaporization* of the volatile liquid through the application of heat. The next step is distinctive and opposite, and consists in the conversion of this vapor into a liquid by the application of cold: this part of the process is called *condensation.*

The elements of distillation are: 1, vaporization, and, 2, condensation. The subject of vaporization was treated of in the preceding chapter: we have now to consider condensation.

Condensation.—It has been already shown (page 101) that when a *liquid* is *vaporized* a certain amount of heat disappears or is rendered latent, and when a *vapor* is *liquefied* a corresponding degree of heat is evolved or reappears. Whilst the practical application of this law is of great service in the use of steam for heating purposes, the opposite process of condensation shows its disadvantages, because of the relatively large quantity of cold water necessary to liquefy vapors.

The greater the difference in temperature between the condensing surface and the vapor, the more rapid is the condensation; and it has been computed that steam at 100° C. (212° F.) requires about twenty-five times its weight of water at 20° C. (68° F.) to condense it. The proper relation between the heating and condensing surfaces of apparatus used in distillation can only be known by careful study of the laws governing vaporization and condensation, or by practical experience.

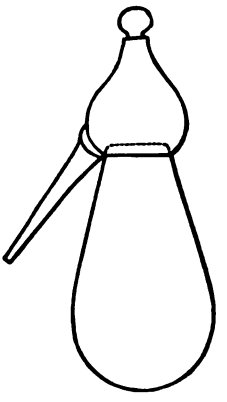
Apparatus used in Distillation.—In considering the many kinds of apparatus used in distillation, two typical forms are presented: 1, the *alembic form*, in which the vapor is condensed in an enclosed space immediately above the heated liquid, and, 2, the *retort* form, in which the vapor is condensed in a vessel placed at one side of that containing the heated liquid, and connected with it by a suitable tube or pipe.

The Alembic.—This is probably the most ancient kind of distillatory apparatus, and in its original form it is now rarely employed. The *body*, or *cucurbit*, is usually globular or oval in shape, and at its junction with the hemispherical *head* or *dome* there is a gutter or groove. This serves to collect the condensed vapor or distillate, which is carried off by a tube, as shown in the illustration (see Fig. 124).

Fig. 125 shows an alembic which, according to Mr. Brady, of Newcastle, England, is still frequently employed in Japan. Into the boiler, *a*, is fitted a short cylinder, *b*: this has a perforated bottom, and the gutter communicates with the spout; the condenser, *c*, has a cover, *d*,

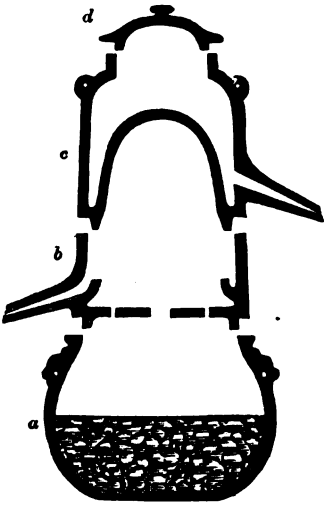
and is also furnished with a spout for carrying off the water used in cooling the dome after it has been heated by the vapors rising from the boiling liquid in the body. This still, or, as it is called by the Japanese, *lambik*, is shown because it represents the alembic probably in one of its

FIG. 124.



Alembic.

FIG. 125.

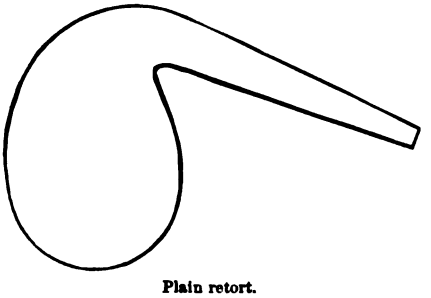


Japanese lambik.

best practical forms, and the advantages possessed by this kind of distilling apparatus are seen to be compactness and simplicity. It is, however, not fitted for distilling very volatile liquids, is very inconvenient and troublesome, because of the necessity for constantly replacing the water used in the condenser, and distillation is slow and tedious.

The Retort.—This form of distillatory apparatus has many advantages over the alembic, which it has almost entirely replaced. A retort, in its simplest form, may be described as a long-necked glass flask in which the neck, after being heated thoroughly, is bent over until its axis makes an acute angle with that of the bowl of the flask. Retorts are of two kinds,—plain and tubulated. A *plain* retort has just been described (see Fig. 126). If it has a *tubulure* or orifice at the top of the bowl for the purpose of introducing the liquid to be distilled, it is said to be *tubulated* (see Fig. 127). Retorts are made of glass, porcelain, earthenware, platinum, iron, lead, etc., according to the purposes for which they are designed.

FIG. 126.



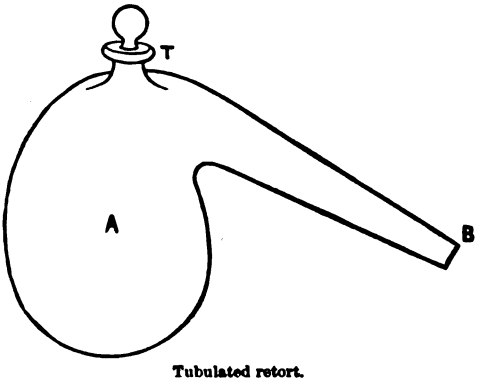
Plain retort.

Porcelain and earthen-ware retorts are used in the distillation of

phosphorus, mercury, etc.; platinum and iron retorts, in destructive distillation; leaden retorts, in making hydrofluoric acid, ether, etc.

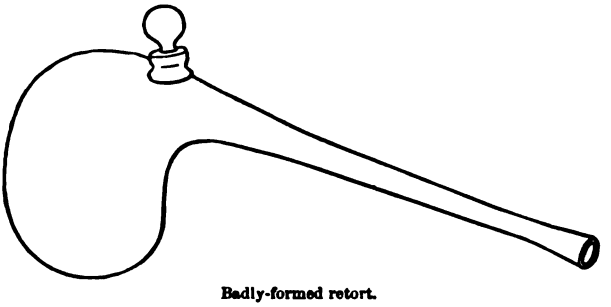
The glass retort is the only kind, however, which will be considered here in detail. The shape of a retort is an important point to regard in its selection: retorts having deep bowls are best suited for very volatile liquids. The lower surface of the neck of the retort should form a decidedly acute angle with the surface of the bowl if tubulated; a line drawn from the centre of the stopper should touch the centre of the bowl, A, so that when a funnel is introduced into the tubulure, T, to charge the retort, the contents may all be delivered into the bowl without soiling or splashing the neck. The neck of the retort should gradually taper to the end, and the beak, B, should never be larger in diameter than any other portion of the neck, otherwise difficulty may be experienced in making joints with adapters, receivers, or condensers (see Fig. 128). Such a fault may prevent the use of a cork ring in joining, for this ring should be made tight by forcing it up the gradually-increasing diameter of the neck. The glass forming the retort should be carefully annealed and have a uniform thickness: extremes should be carefully guarded against. If the glass be too thick, the sudden changes in temperature, to which retorts are constantly subjected in distillation, may cause fracture; on the other hand, if too thin, they are easily broken in cleaning. Scratches and imperfections in the bowl should cause retorts to be rejected.[1] The objections to the use of retorts are mainly due to

FIG. 127.



Tubulated retort.

FIG. 128.

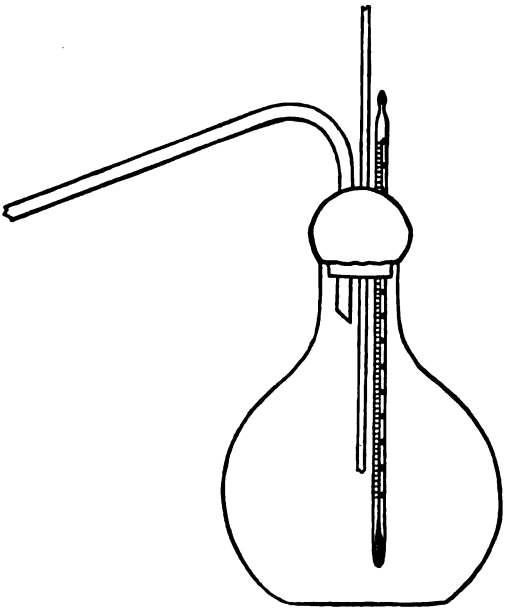


Badly-formed retort.

[1] Although there is no disposition on the part of the author to weaken the force of this conventional advice, the possession of a retort having a large bubble in the bottom of the bowl, which has been in successful use for ten years and has outlasted many of its more perfect fellows, supplies the needed exception.

their peculiar shape, the principal one being the difficulty of cleaning them thoroughly. The necessity for having a variety of different shapes and sizes to suit special operations is greater than when distillation is performed with flasks and bent tubes.

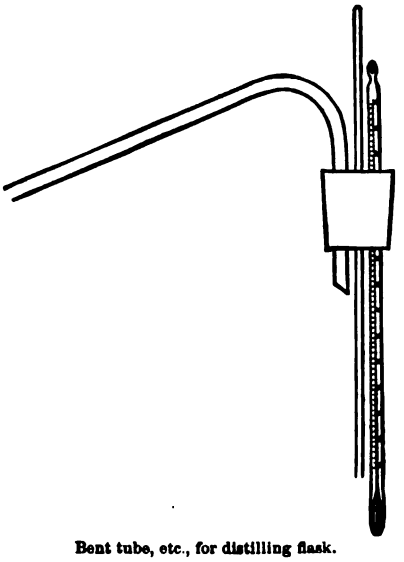
FIG. 129.



Distilling flask.

Flask distillation will be usually found most practicable for pharmaceutical work. The best shape for a flask is shown in Fig. 129. The bowl should have a flat bottom, so that it will stand unsupported; the neck should be wide, to admit a large cork, so that there will be plenty of room for a wide bent tube, a thermometer, and a safety or charging tube (see Fig. 130). The advantages of using a flask instead of a retort for all distillations that will allow of it are several: it is easily cleaned, it is useful for other purposes, for instance as a measure, as a container, or as a receiver for the distillate, and the parts are readily replaced in case of breakage. One of the most important parts of this apparatus is the bent tube for conducting the vapor to the receiver or condenser: the diameter of the tube should be as large as the receiver or condenser will conveniently accommodate.

FIG. 130.



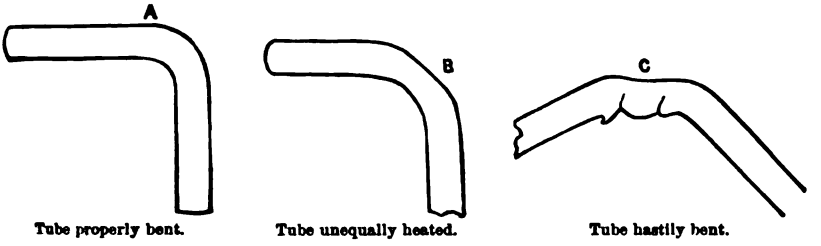
Bent tube, etc., for distilling flask.

Cutting Glass Tubes.—The glass should be moderately thick and of the proper length. A glass tube may be broken neatly by scratching it across with a sharp three-cornered file, and then grasping it with both hands, one on each side of the scratch, and making a slight outward pressure, which will generally produce a clean fracture: by holding the sharp edges for a few moments in the flame the corners

may be rounded so that they will pass through a cork without cutting it and making a ragged edge.

Bending Glass Tubes.—A tube may be bent by heating it properly over a gas-flame. To make a symmetrical curve in a tube of large diameter requires considerable skill and practice. One end of the tube should be closed by a cork, and the part of the tube that is to be bent held just above the flame and gradually rotated between the fingers, so that it may be heated evenly throughout: it should also be passed to the right and left through the flame for the space of an inch or two on each side of the middle of the proposed bend, and very slowly allowed to curve in one direction, so that the bend shall not be too abrupt. The object of closing one end with a cork is to prevent a current of air from passing through, and, in case collapse from overheating occurs, by gently blowing in the tube the softened glass may be swelled to its proper curve. Fig. 131 shows a tube properly bent, while Figs. 132 and 133 illustrate some of the defects produced by unskilful work. In Fig. 132 the tube was not rotated evenly, and at the top of the bend,

FIG. 131. FIG. 132. FIG. 133.



Tube properly bent. Tube unequally heated. Tube hastily bent.

B, it was hot enough to collapse. Fig. 133 represents the effects of hurry and unequal heating, the operator having forced the bend, C, before the tube was heated uniformly. A gas-burner having a solid, steady flame is the best kind to use (see Fig. 60), and draughts of air should be avoided.

Cork-Fitting.—Corks for joining apparatus should be of *the best quality.* They are perforated for the passage of the glass tubes by the use of cork-borers (see Fig. 134). These are cylindrical brass tubes of various sizes, sharpened at one end, and surmounted by a milled-brass cap: they are furnished in sets. A small hole is drilled through both sides of the brass cap, so that an iron rod may pass directly through it and form a convenient handle. They are used by holding the cork firmly with the left hand and pushing the borer through with the right hand, using a twisting motion at the same time so as to cut a smooth round hole. The mistake frequently made in using cork-borers is due to "hurry:" the attempt to force the borer through quickly without rotating it sufficiently, always ends in breaking off pieces of the cork. The cork-borer shown in Fig. 135 is much more convenient for larger corks, and should be used where cork-borers are often needed, the tool-handle, I, being large enough to give the operator a firm grasp, so that the cork may be readily bored. The cutting edge of the borers should always be kept sharp and in good condition by the use of the grindstone

or emery-paper. When the cutters do not bore a hole of the exact size needed for the glass tube, which of course should fit tightly, it is best to select a borer which will cut a smaller hole than that desired, and then to enlarge the hole by filing with a rat-tail or half-round file (see Fig. 136). When the tubes have been fitted, the cork should usually be thoroughly soaked in hot water, for the purpose of swelling and softening it: it should never be soaked before cutting or filing. The rasp and file shown in Fig. 137 will be useful in fitting up large flasks. Rubber corks can often be used with great advantage, and they may be readily perforated by dipping the cork-borer in solution of caustic soda or potassa or strong water of ammonia before beginning to use it. If rubber corks are well dried by wiping them thoroughly, they may be filed easily with a new, sharp, flat file. The main

FIG. 136. FIG. 137.

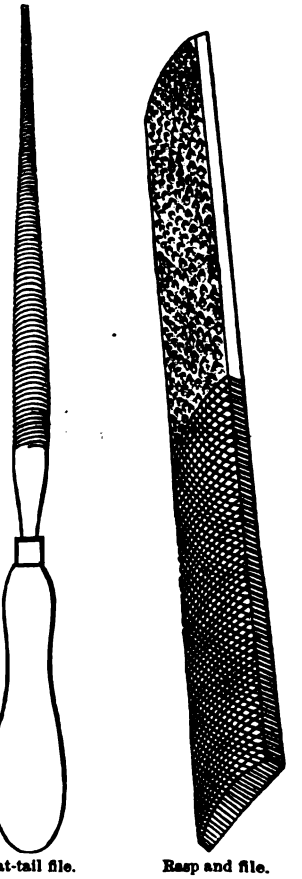
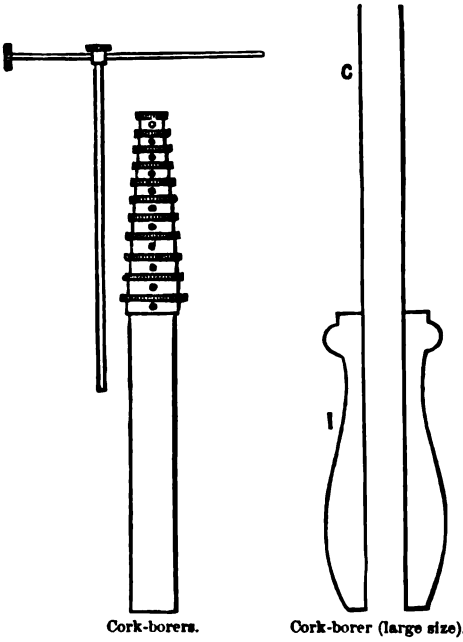


FIG. 134. FIG. 135.



Cork-borers. Cork-borer (large size). Rat-tail file. Rasp and file.

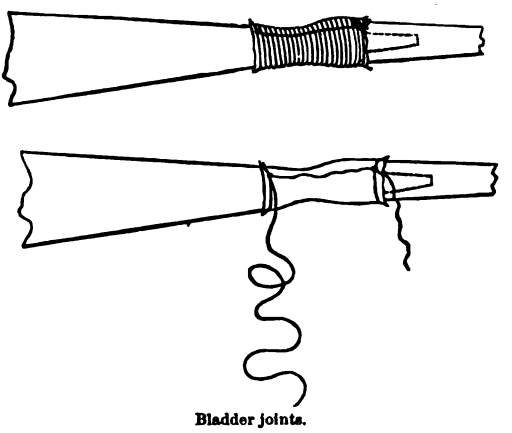
advantage of rubber corks is that they are practically impervious to vapors or gases, and hence require no luting. Substitutes for rubber corks may be made by keeping dry corks in melted paraffine or wax until the pores are thoroughly filled, and then cooling.

Lutes.—The most satisfactory lute for ordinary distillations is made by adding flaxseed-meal to *boiling water* and stirring until a thick, sticky mass results. When the perforated and soaked cork containing the tubes is inserted in the neck of the flask, a small quantity of lute

should be pressed into the joints, and then followed by sufficient to make the joint vapor-tight, the quantity varying with the quality of the cork and the character of the vapor that is to be excluded. If future trouble from leaking is to be avoided, it is usually better to throw away a cork which will not make an almost perfect joint without lute, rather than trust to cover up serious deficiencies with lute. A neat finish may be given to the joint by dipping a finger into water, and with it smoothing the surface of the lute. In Fig. 130 the cork is shown perforated and mounted; in Fig. 129 it is luted and in position.

Bladder Joints.—One of the most useful substances to the practical pharmacist who has occasion to join tubes is a strip of moistened bladder. Hogs' bladders are usually preferred, and it is now possible to get them of excellent quality prepared by being thoroughly cleaned and then soaked in an alkaline solution or in benzin to deprive them entirely of fat. In connecting two tubes of different diameters which are not to be subjected to a high heat, a bladder joint is especially useful. For an ordinary joint of inch glass tube, a strip about six inches long and an inch and a half wide should be moistened and wrapped around the proposed joint; the upper end of the bladder is then tied tightly with strong linen twine, leaving the short end of the twine at least six inches long; this end is carried along the top of the bladder and tied tightly around the lower end of the joint; the long end of the twine is then wrapped spirally and regularly around the bladder until the lower end is reached, when it should be there tied tightly (see Fig. 138). Strips of writing-paper soaked for a few moments in water, and then coated with ordinary, smooth flour-paste to which ten per cent. of glycerin has been added, may also be used for joining apparatus.

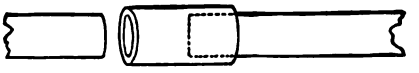
FIG. 138.



Bladder joints.

Rubber joints are preferred to bladder joints when there is no likelihood of vapor or high heat dissolving or softening the rubber, and when the tubes to be joined are nearly of the same diameter: the ease and celerity with which such joints can be made are their strong points. A piece of rubber tubing is cut of slightly less diameter than that of the tubes to be joined; by moistening the rubber on the inside with water, and stretching it over one end of the glass tube, and then inserting the end of the other glass tube, the joint is made. Success largely depends upon having the rubber tube slightly smaller in diam-

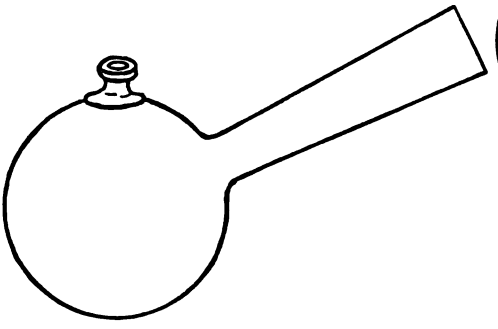
FIG. 139.



Rubber-tube joint.

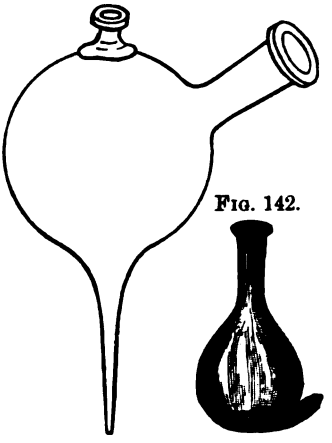
eter than the glass tube, so that the elasticity of the rubber alone will be sufficient to make a tight joint, otherwise the rubber tube must be tied on, and then the advantage over a bladder joint is lost (see Fig. 139). In all cases it is preferable to select tubes which differ slightly in diameter, so that one may slip into the other, the narrower of course having the higher position, so

FIG. 140.



Tubulated receiver.

FIG. 141.



Tubulated and quilled receiver.

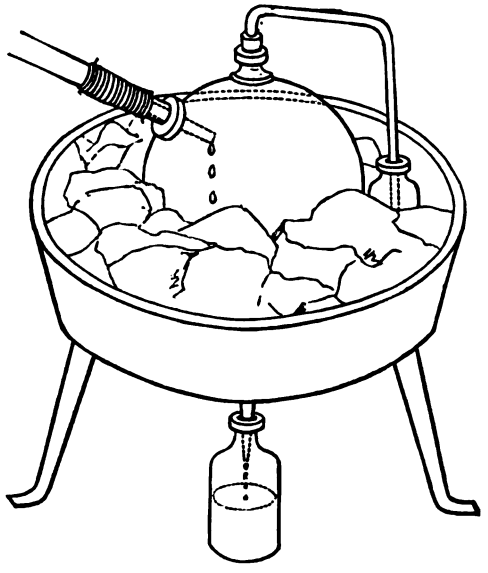
FIG. 142.

Plain receiver.

that the vapor or liquid shall not come in direct contact with the rubber.

Receivers are glass vessels, usually globular in shape, intended to receive distillates. They are of three kinds,—*plain*, *tubulated*, and *quilled* (see Figs. 140 and 141). When a plain receiver is required, an ordinary flask (see Fig. 142) will answer, but if uncondensable vapors are produced, it is necessary to provide for their escape, or an explosion may occur from the accumulated pressure: this may be done in a tubulated receiver by occasionally removing the stopper, or, better, by connecting a bent glass tube with the receiver and allowing the end of the tube to dip into water, or into an acid solution if the vapors be alkaline, or into an alkaline solution if the vapors be acid. A quilled receiver is useful where the distillation is to be carried to a definite point and a certain amount of distillate is to be received, or, as in the prepara-

FIG. 143.

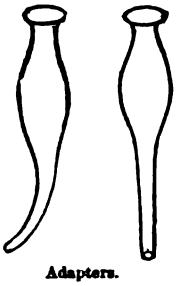


Mode of using quilled receiver.

tion of hydrocyanic acid, the end of the quill is made to dip below the surface of the cooled diluted alcohol or water, in order to condense all of the gas. In the distillation of very volatile liquids an effective mode of using a quilled receiver is shown in Fig. 143. A hole is cut in the bottom of a rather shallow tin pan and a short tube soldered into it; a perforated cork will permit the quill of the receiver to pass through it, and at the same time a tight joint should be made; ice or snow is heaped up over the receiver, and any uncondensible gases may escape from the bent tube in the tubulure or be absorbed by the liquid into which the tube dips.

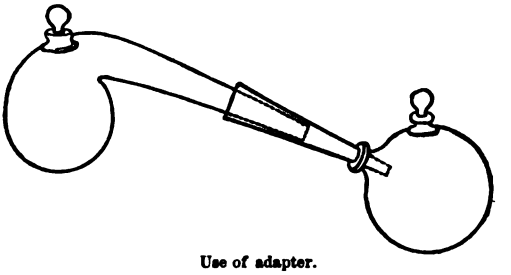
Adapters are tapering tubes of glass which are used to connect retorts with receivers. Fig. 144 shows the bulbed and bent form. Good adapters may be made from retorts having broken bulbs by cutting off

FIG. 144.



Adapters.

FIG. 145.

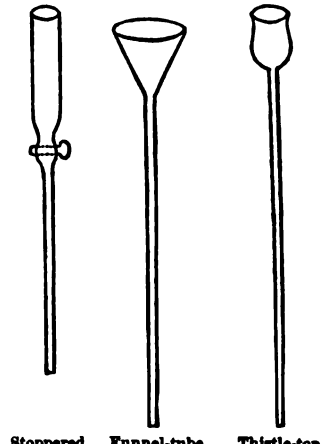


Use of adapter.

the broken portion, scratching the tube with a file, and extending the crack thus made entirely around it by slowly passing a red-hot poker over the line marked for the fracture. Fig. 145 shows an adapter of this kind in position.

Charging Retorts.—Plain retorts must be charged by using a funnel-tube: this may be a funnel with an elongated tube, or a modification of it, as shown in Figs. 146, 147, and 148, or one may be improvised by selecting a tube of sufficient diameter to permit of the introduction of a small funnel (see Fig. 149). The object of using a funnel-tube is to prevent the soiling of the neck of the retort; as the object of distillation is usually to purify the liquid, the latter must be delivered into the bowl of the retort without touching the neck. Fig. 150 shows the method of charging a plain retort; a small piece of rubber tube, R, is sometimes placed on the end of the funnel-tube to guide the liquid safely. Tubulated retorts are charged by simply placing a funnel in the tubulure and pouring the liquid in.

FIG. 146. FIG. 147. FIG. 148.



Stoppered funnel-tube. Funnel-tube. Thistle-top funnel-tube.

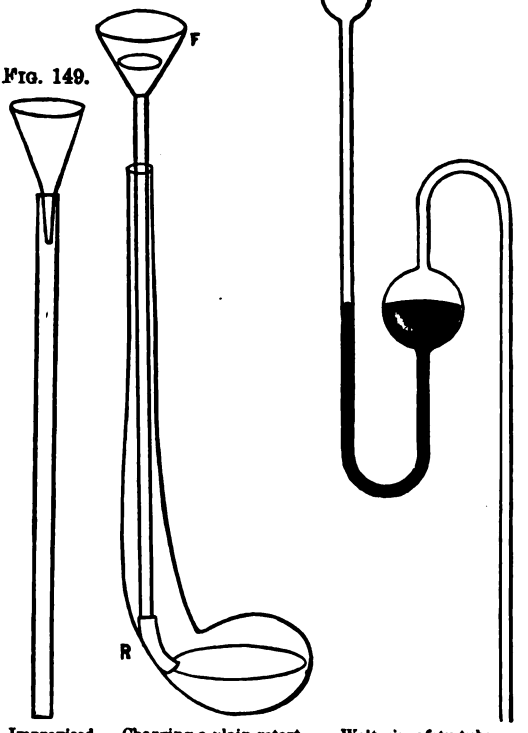
Safety-Tubes.—It is sometimes impossible to avoid sudden evolu-

tions of vapor during distillations. When there is a likelihood of such occurring, it is advisable to insert a Welter's safety-tube into the tubulure of the retort. This tube (see Fig. 151) is bent into the form of an S, having a bulb blown in the middle, and a thistle funnel at the top. Mercury is poured into the tube before inserting it into the tubulure of the retort, and a piece of loose cotton is placed in the thistle funnel; when undue pressure occurs, the mercury is forced into the cotton and the vapor escapes; when the retort has been thus relieved, the mercury descends into the bulb and the distillation proceeds.

FIG. 151.

FIG. 150.

FIG. 149.

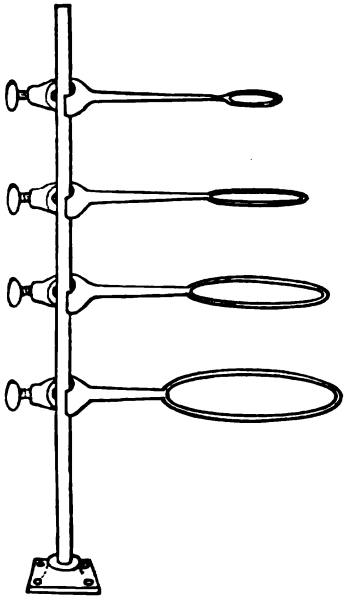


Improvised funnel-tube. Charging a plain retort. Welter's safety-tube.

Retort-stands are used to support properly retorts, flasks, receivers, etc., during distillation, although they are also employed by pharmacists for a variety of other purposes, as in filtration, percolation, evaporation, etc. Fig. 152 shows a retort-stand which has been used with much satisfaction in the laboratory of the Philadelphia College of Pharmacy. It is more substantial than those that are commonly furnished by the chemical-apparatus makers. The clamp (see Fig. 153) is made upon the principle of one originally devised by S. Lloyd Wiegand, and is hook-shaped, so that any of the different sizes of rings may be unscrewed from the upright rod without disturbing the rest. In many of the common retort-stands the bottom ring cannot be removed without first slipping off all above it. Fig. 154 shows the ordinary retort-ring. The almost universal fault of the retort-stands in common use is their extreme lightness and want of stability; the rings frequently bend under such weights as should be easily borne, and, owing to the base being too light and small, the whole stand is sometimes upset during an operation. In the stand shown in Fig. 152 the base-plate is permanently fastened to the operating counter in a place known to be the most convenient; if the counter is one that must be used for other purposes, the base-plate may be screwed to the under side of the counter, and a five-eighths-inch

hole bored through the counter, so that the centre shall coincide with the centre of the hole in the base-plate. When the retort-stand is not in use, the hole in the counter may be closed with a cork. The upright is made of half-inch iron tubing, and can be quickly screwed into the base-plate

FIG. 152.

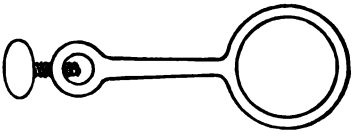


Retort-stand.

FIG. 153.

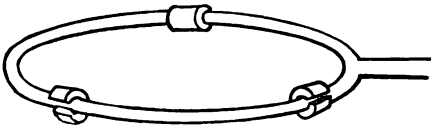
Retort-ring clamp.

FIG. 154.



Retort-ring.

FIG. 155.



Ring with split sections of rubber tubing.

with the hands without the use of pipe-tongs. The rings and clamps are in one piece, and are made of malleable iron, so that if dropped on the floor they are not likely to break. When used for holding a glass percolator or funnel, the danger of fracture on account of the contraction of the iron ring may be avoided by stretching three split sections of rubber tubing upon it (see Fig. 155).

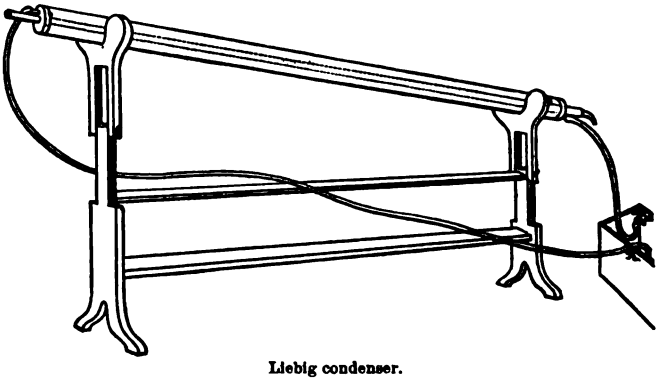
Bumping is the term applied to a phenomenon occurring when certain liquids are heated to the boiling-point in glass vessels. Ebullition often proceeds regularly at first and the vapor is given off continuously, when suddenly the surface of the liquid will become smooth for a few seconds. This is succeeded by a slight explosion, when the accumulated vapor is violently expelled and the liquid is said to "bump:" these effects occur alternately, and increase as distillation progresses, and some liquids, particularly sulphuric acid, cannot be distilled in glass vessels without using certain precautions. The exact cause of bumping has not yet been satisfactorily explained, but the fact that the forces of cohesion and adhesion in certain liquids are greater when they are boiled in glass vessels than in metallic vessels has been proved. The expedients that have been used to prevent bumping, or rather to lessen its effects, usually consist in the addition of some insoluble solid substance to the liquid, such as broken glass, a fragment of charcoal (when admissible), piece of clay pipe, rock crystal, etc.; these serve to break

the explosive force of the vapor in its upward course, and are thus serviceable. Probably as good an expedient to use as any in pharmaceutical operations, is to add a few pieces of glass of irregular shape to the liquid before it is heated.

LIEBIG'S CONDENSER.

This condenser, although now bearing the name of the great chemist, was used before his time. It consists of a long glass tube, surrounded by another tube of larger diameter; two small openings are made, one near the bottom and the other near the top of the large tube. Connection is made with the tube leading to the bottom with a cold-water supply, and the water circulates in the space between the inside of the large tube and the outside of the smaller tube, and finally has its exit at the opening near the top. Fig. 156 shows a large condenser of this

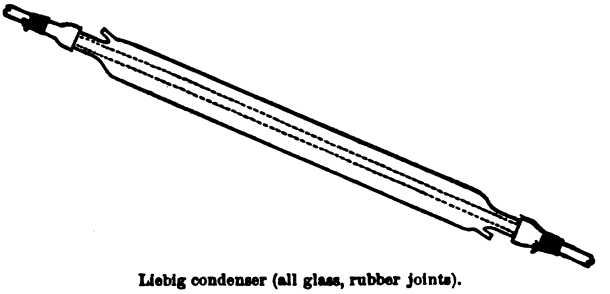
FIG. 156.



Liebig condenser.

form, well suited for illustrating the process of condensation practically. Both tubes are of glass, the ends being of rubber, and made by cutting

FIG. 157.

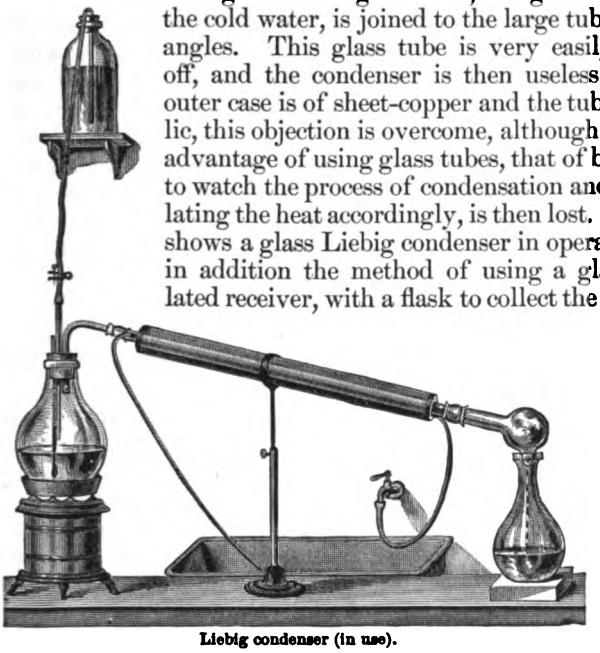


Liebig condenser (all glass, rubber joints).

two sections from a clothes-wringer roller; the lowest rubber cork is perforated at its lowest convenient point, for the introduction of a short piece of glass tubing, and the upper rubber cork is similarly perforated for the same reason. A rubber tube connects the lower short glass tube with the cold-water supply, whilst another rubber tube, connected with

the upper short tube, carries off the warmed water. For smaller condensers the form shown in Fig. 157 answers very well; the outer glass tube is contracted at the ends and supplied with short tubes as shown, a rubber tube or bladder joint being used to make the joint between the condenser tube and the outer tube. This form is recommended in preference to the kind frequently sold, in which a long and thin glass tube, designed to supply the cold water, is joined to the large tube at right angles. This glass tube is very easily broken off, and the condenser is then useless. If the outer case is of sheet-copper and the tubes metallic, this objection is overcome, although the great advantage of using glass tubes, that of being able to watch the process of condensation and of regulating the heat accordingly, is then lost. Fig. 158 shows a glass Liebig condenser in operation, and in addition the method of using a glass tubulated receiver, with a flask to collect the distillate,

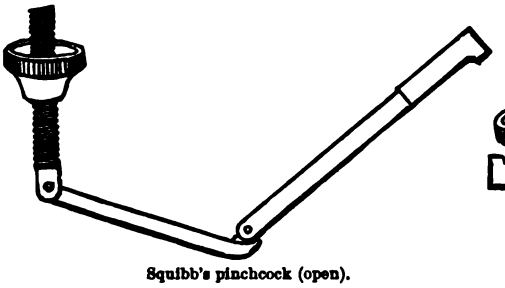
FIG. 158.



Liebig condenser (in use).

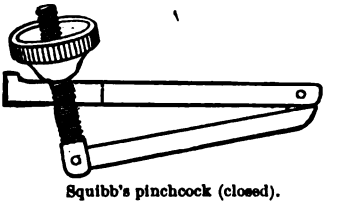
The liquid which is being distilled is gradually supplied to the distilling flask by the feed-tube from the contents of the bottle on the shelf; the rate of flow is controlled by a pinchcock compressing the rubber tube. An enlarged view of the best form of pinchcock to use for this purpose is shown in Figs. 159 and 160. It was contrived by Dr. Squibb to overcome the annoyances experienced in using the ordinary forms. It can

FIG. 159.



Squibb's pinchcock (open).

FIG. 160.

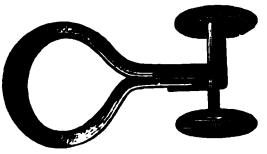


Squibb's pinchcock (closed).

be easily and quickly applied to or removed from a rubber tube without breaking a joint, and much more perfect control of the flow can be

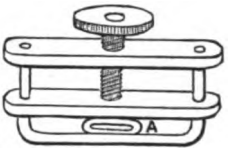
secured than by the form seen in Fig. 161, which is known as Mohr's. Hoffman's screw pinchcock (see Fig. 162) is often useful, but it cannot be applied or removed so conveniently as Squibb's. A section of compressed tube is shown at A. Fig. 163 shows a method of refrigeration which may be used when the ordinary condensers and a steady supply of water are not to be had. A wide tube is connected with the distilling flask, and some lint, lamp-wick, or other absorbent material is wrapped spirally around it and tied at the ends; a square piece of cardboard is perforated so that it will fit tightly upon the tube, and it is pushed upon the lower end until it is in close contact with the lint; if water can be supplied from a faucet, a rubber tube is connected with it and conducted to the upper part of the condensing tube, and tied in such a position that a stream of water will trickle from it and be carried down by the lint until it reaches the cardboard, where it falls into the vessel prepared to receive it. If hydrant water is not available, a large bottle containing water may be placed upon a shelf, and a syphon, having a rubber tube and pinchcock, attached, as shown in the cut.

Fig. 161.



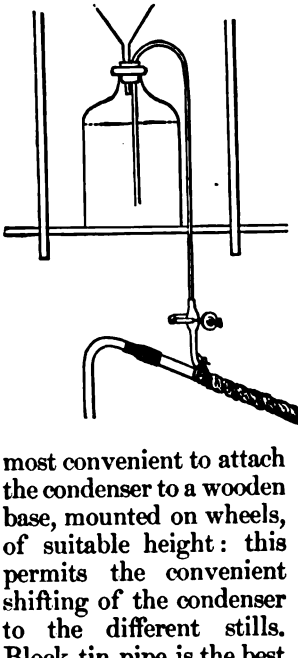
Spring pinchcock (Mohr's).

Fig. 162.



Screw pinchcock (Hoffman's).

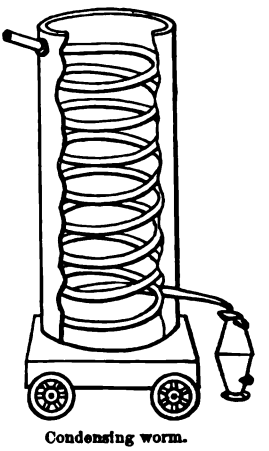
Fig. 163.



Tube condenser.

The Condensing Worm.—The method of condensing by the use of the worm is very old, and its advantage in securing economy of space and its ease of application are very apparent. Fig. 164 affords a good illustration of this kind of condenser used in the larger laboratories. It will be found most convenient to attach the condenser to a wooden base, mounted on wheels, of suitable height: this permits the convenient shifting of the condenser to the different stills. Block-tin pipe is the best that can be used for general pharmaceutical work. Copper or tinned-copper tube should be avoided, because it is impossible to prevent the action of acid vapors or liquids upon the copper; soluble salts of copper would thus be

Fig. 164.



Condensing worm.

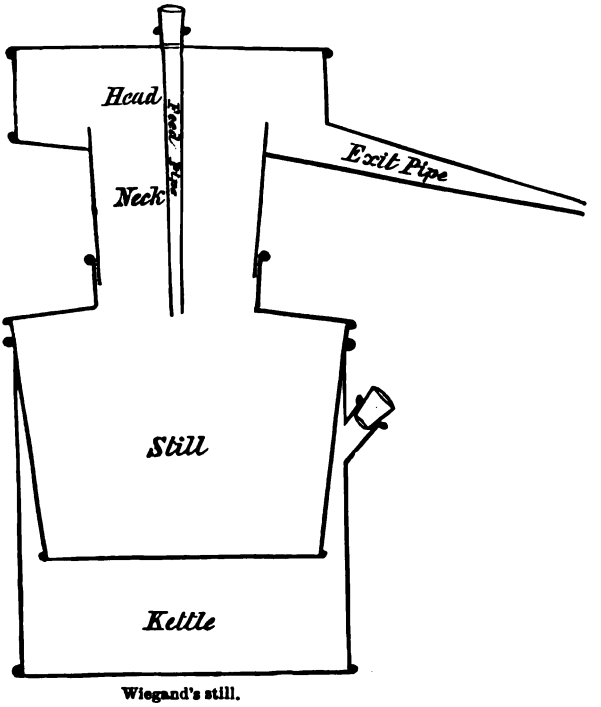
formed and the distillate often rendered poisonous. Iron tube is not admissible, on account of the contamination from iron salts; pure tin is not affected so easily, and the salts that possibly would be formed are not so objectionable. Block-tin pipe may be wound spirally around a convenient cylindrical vessel, such as a tin can or similar object, to give it the proper shape, and then fastened to three notched uprights and placed in position, as shown in Fig. 164. Earthen-ware condensing worms of all sizes, of excellent quality, are made by Doulton & Watts, Lambeth, London, England, and by John Cliff & Sons, Leeds, England. For condensing acid vapors, as in making spirit of nitrous ether, these condensers are undoubtedly superior to metallic ones.

PHARMACEUTICAL STILLS.

Stills are preferred in all distillatory operations where the liquids or vapors do not act chemically upon the metals of which they are made. Tinned copper is the best material to use in the construction of stills, for, although tinned iron is cheaper, the greater durability of the former renders them in the end more economical. The same typical forms may be seen in the construction of pharmaceutical stills as in glass distillatory apparatus,—*i.e.*, the alembic and retort.

Pharmaceutical Stills—Alembic Principle.—One of the most useful stills constructed on this principle was devised by Prof. Procter in 1847. The still body was connected with the condensing head or dome by a water-joint, and the sides of the dome were continued up into the head so that an alembic-gutter was formed to catch the condensed liquid; this was delivered at the spout, and this spout was partly surrounded by the jacket. Water for refrigeration was supplied by a tube; this first circulated around the delivery-spout, and then found an exit through a rubber tube. Wiegand's still is shown in Fig. 165. It differs from Procter's principally in the method of joining the head of the still to the body;

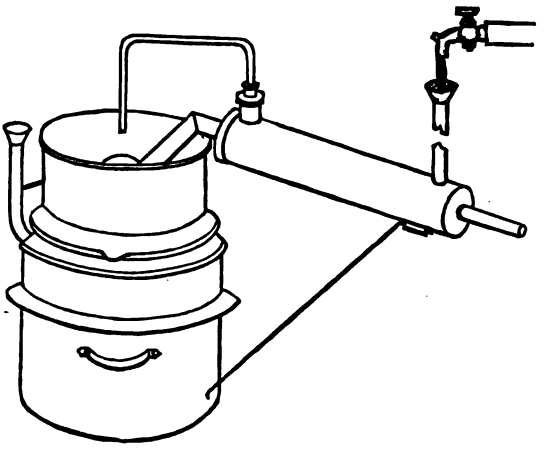
Fig. 165.



Wiegand's still.

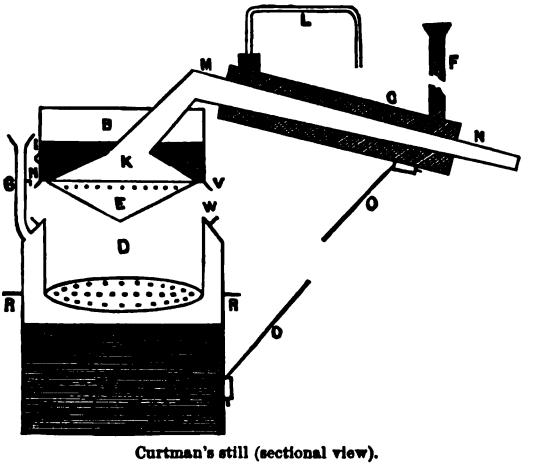
the sides of the head are tapering, so that the head can be pressed down tightly into the body, and with the aid of flaxseed lute a tight joint can be made; the feed-pipe is useful in charging the still, from the fact that it carries the liquid below the point where it would be likely to soil the condensing surface by splashing. Prof. Curtman's still (see Fig. 166) has several modifications about it which require special notice. The jacketing of the neck of the alembic, which is partially carried out in Procter's and Wiegand's stills, is extended so that it is converted into a Liebig's condenser; a bent tube, L (see Fig. 167), serves to convey water partially heated from contact with the vapor over into the head, B: this modification is especially intended to strengthen alcohol which is in process of recovery from weak tinctures; the water used for refrigeration circulates around the central tube, N, in the Liebig's condenser, and then finds an outlet into the head B by means of the bent tube L. The intention is to regulate the flow of water so that it shall be sufficient to condense alcoholic vapor passing through the tube, the heated water from L being at the same time of a temperature just above that of the boiling-point of alcohol (180° F.): the vapor of water coming over with the alcoholic vapor comes in contact with this heated surface, and, as the boiling-point of water is 100° C. (212° F.), the temperature of the condensing surface (180° F.) is sufficient to condense the vapor of the water, but not that of the alcohol; thus the water is separated and trickles back into the still, while the alcoholic vapor passes on into the Liebig con-

FIG. 166.



Curtman's still.

FIG. 167.

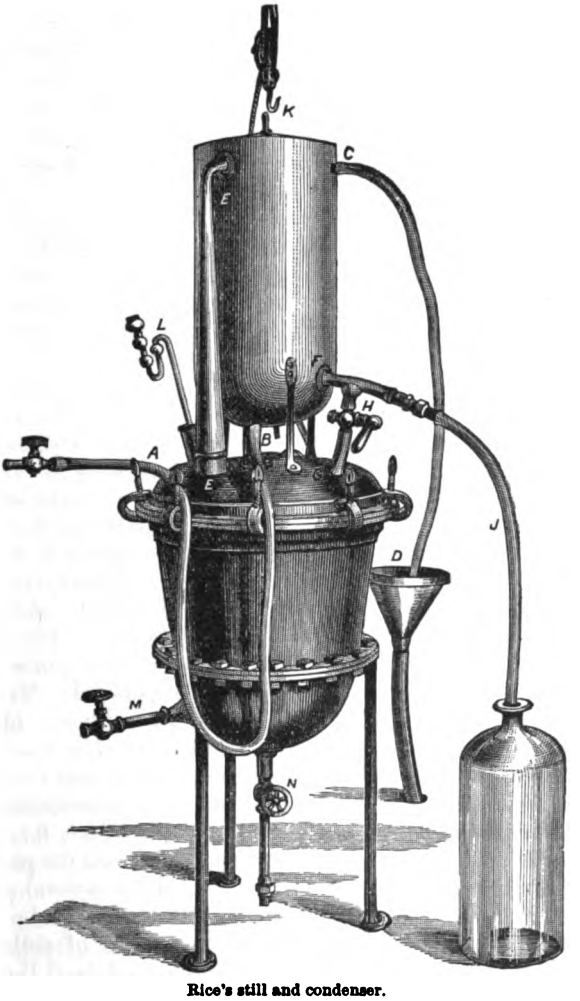


Curtman's still (sectional view).

denser, and is there condensed and recovered. (See Fractional Distillation, p. 137.)

The distilling apparatus known as the Prentiss still, or alcohol reclaimer, possesses some peculiarities, a portion of the vapors being condensed immediately over the still: the still body has an upright column screwed to it; this connects by a union joint with the condenser, which is a single pipe bent into a zigzag form and terminating in a spout. The water intended for refrigeration is poured into the funnel at the top. The distinctive feature, however, is the series of perforated diaphragms which are soldered to a central rod and are placed inside of the column; these are asserted to impede the passage of and condense aqueous vapor when mixed with that which is alcoholic; the alcoholic vapor passes over and is converted into alcohol in the condenser, whilst the condensed water falls back into the still.

FIG. 168.



Rice's still and condenser.

A condenser contrived by Charles Rice, in which the block-tin worm is enclosed and placed immediately above the still head, is shown in Fig. 168. The still is heated by steam, which enters at *M*, *N* being the exhaust-pipe. The still head is constructed of copper. The condenser is a cylindrical copper vessel, with rounded bottom and closed top, having short half-inch tubes projecting from the bottom and from the top at *B* and *C*. There are two such tubes at the bottom, one for attaching the rubber hose, *A*, bringing the water; the second, shown in the cut immediately alongside the letter *B*, is closed with

a cork, and is used to permit the water to be emptied without detaching the hose from the other. At the top there are two tubes, one at *C* for attaching rubber hose to carry off the water into the waste-pipe *D*; the other, which is closed with a cork, is not shown in the cut, as it is on the back of the condenser.

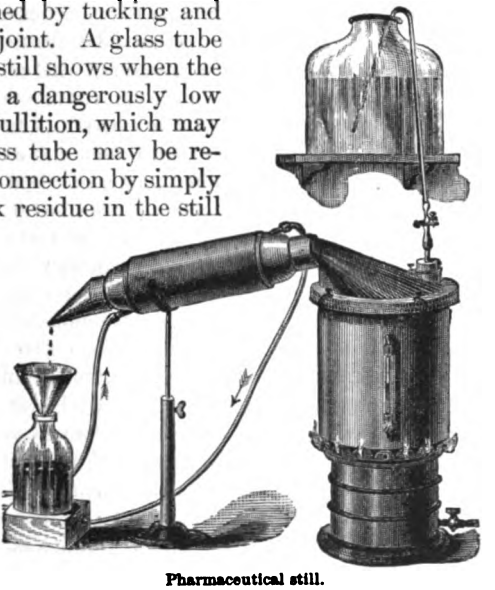
The head of the still carries three short tubulures, only one of which is visible in the cut: this one contains a cork bearing the safety-valve, *L*. A second one is at the other side, for refilling the still when required, with another narrower tube intended for the insertion of a thermometer. The condensing pipe begins at *E*, where it rises from the head parallel with the condenser. It is made of copper as far as the point indicated by the upper *E*, where it is soldered to the *downward projecting* upper end of the block-tin worm contained in the condenser and emerging from it at *F*. This arrangement makes it impossible for any condensed liquid to come in contact with anything but block-tin. The worm inside the condenser is made by carefully winding block-tin pipe upon a round block of wood, taking particular care to give the coil a uniform downward descent throughout. After emerging from the condenser at *F*, it extends for a short distance, where the cut shows it to be connected to the separate block-tin pipe, *J*, by means of a union joint lined with tin. Half-way between *F* and the end proper of the worm the pipe is tapped, and a branch, carrying the faucet *H*, leads into the still at *G*, where it terminates under the centre of the head in the form of an ᔓ, forming a trap to prevent the escape of vapors by this passage. The object of this arrangement is to cause the condensed liquid to flow back into the still as long as the faucet *H* is open, or to collect it outside by turning off the faucet. Prolonged digestions with alcohol may be made by means of this apparatus without any loss of liquid. The head is attached to the still by means of a rubber washer and iron clamps, and when it is desired to remove it the water is allowed to drain from the condenser, the clamps are taken off, and the whole is hoisted up by the tackle *K*, and set on one side.

Pharmaceutical Stills—Retort Principle.—The method of condensing vapors by cooling them in a separate vessel connected with the still by a tube or tubes has been largely employed. The simplest plan is to connect the still head with a Liebig's condenser or a worm. The principal disadvantage of the former method is that considerable space is required in providing for the long tube and its refrigeration, and this is an important consideration in most laboratories. The disadvantage about the worm is one which is still greater, for, whilst space is economized, the spiral shape of the worm prevents the possibility of thoroughly cleaning it, and where a still is used for several purposes the odor and taste of the last liquid used in the still will be very apt to pervade and contaminate the distillate in process of collection. Kolle, in his endeavor to overcome these objections, retained the condensing tub, but, instead of using a worm, bent the pipe into a zigzag form and adjusted it in a vertical plane, the angles of the zigzag tube upon one side projecting through the sides of the tub: these projecting angles were made of separate, short pieces of tube, which were cemented to the condensing pipe. The objection to this condenser was the incon-

venience of breaking and making so many joints. Mitscherlich improved Gadda's condenser by constructing a condenser from two cylindrical vessels, the inner one removable and yet capable of being connected with the outer vessel by a tight joint: deficiency of condensing surface and the inconvenience of making vapor-tight joints were objectionable in this condenser.

From a consideration of the necessity for some new plan for condensing liquids in pharmaceutical stills, whereby the above objections could be overcome, the author was led, in 1872, to employ the principle of the tubular boiler for condensation (see Fig. 169). The body of the still is made of tinned copper; the bottom is not rounded, but flat, permitting it to stand securely on an ordinary counter; the bottom is made of heavier copper than the sides, and is fastened by tucking and folding, thus making a tight joint. A glass tube water-level on the side of the still shows when the liquid has been distilled to a dangerously low point, as well as too active ebullition, which may result in frothing. The glass tube may be removed from the rubber-tube connection by simply slipping it out, and if a thick residue in the still remains, it may be transferred to a bottle or dish by allowing it to escape at the lower tube orifice, thus avoiding loss of product by waste. The still body is connected with the top by a "twine joint," a flat brass ring being soldered to the top of the still body, and another of exactly the same size being soldered to the still top or dome. When the connection is to be made, a piece of soft, thick twine, two inches longer than the circumference of the ring, is soaked in water, and carefully laid upon the brass ring in such a way that the ends overlap; the top is then carefully laid upon the wet twine and securely fastened with clamps, which should be applied at opposite points at the same time, so as to bear equally.

FIG. 169.



Pharmaceutical still.

The *still top* differs from most others in having the opening for the escape of vapors drawn over to one side, instead of in the centre; by this arrangement the condensing surface of the dome is reduced to a minimum, and condensation *inside the still* is obviated as far as possible.

The construction of the condenser shows the application of a well-known principle which has been made to do service for an opposite purpose. The substitution of a number of tubes of small diameter for one large vessel is recognized as an effective means of rapidly producing vaporization (see page 104). The principle is of equal value in condensation. The condenser has seven parallel, solid block-tin tubes,

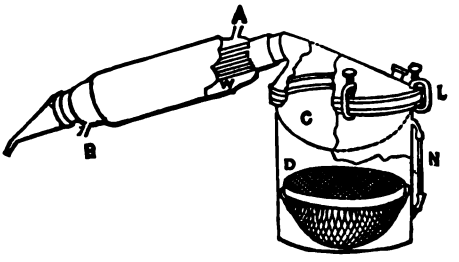
surrounded by a copper case: this case is perforated twice, and a short tube is soldered in at each extremity. To the lower tube a rubber tube is attached, which is connected with a cold-water faucet; a rubber tube is slipped over the upper short copper tube of the condenser for carrying off the water after it has served its purpose of condensing the vapors, which it does by circulating freely between the outer surface of the block-tin tubes and the inner surface of the containing case. The proportions of this condenser are so adjusted that if any liquid likely to be used is actively boiled in the still body, and cold water is running through the condenser, there can be no escape of condensable vapor at the exit-tube. In the condenser for the still holding three gallons the combined length of the tubes is about six feet, and about one hundred square inches of condensing surface are obtained: the condenser itself is fifteen inches long and about four inches wide. Straight, smooth, solid block-tin parallel tubes are used because of the convenience of cleaning them. A piece of cloth wrapped on the end of a rattan or stiff wire may be rapidly pushed through each tube, which serves to clean it when a very odorous liquid has been distilled, but usually it suffices to hold the condenser under a hot-water faucet for a few moments. The methods of connecting the various parts of the apparatus are simple. Two ground-brass joints are made, one at the point of junction of the condenser, with the still head top, and the other where the nose-piece is attached to the end of the condenser: these, on account of their comparatively small diameter, require no clamps or lute, and are vapor-tight. Where a moderate heat below the boiling-point of water is required, the still body is placed in a kettle; and, if the quantity of liquid to be distilled is not large, a round-bottomed, tinned-copper water-bath is clamped between the still body and still head, and the still body filled with water, the waste steam escaping through three apertures in the rim of the water-bath. This water-bath arrangement may be used in addition in making ointments. The automatic feeding attachment consists of a glass syphon, a rubber and a glass tube (the latter passing through a cork), and a pinchcock. The manner of using this is as follows. The still having been charged (about half full), the remainder of the liquid is placed in a vessel above the still body upon any suitable support; the syphon is placed in the liquid, then connected with the rubber tube carrying the pinchcock, and by suction or other means the syphon is filled and the pinchcock screwed down; the other end of the rubber tube is then connected with the glass tube running through the cork, which passes through the tubulure in the still head. Heat is now applied to the still body, the cold-water faucet is turned on to supply the condenser with cold water through the lower rubber tube, and when the distillate comes over in a steady stream a narrow strip of paper is pasted on the glass gauge-tube on the body of the still to mark the level of the liquid at starting. The pinchcock is then opened, and the level of the liquid in the still is regulated so that the liquid neither rises nor falls: this indicates that a stream of liquid from the reservoir above is running into the still exactly equal in volume to that of the distillate running from the exit-tube, and the apparatus may be left to take care of itself. The empyreumatic odor which dis-

tilled and aromatic waters often possess, and which is usually caused by the solid substances lying in immediate contact with the hot still bottom, is obviated in this still by putting the substance into a hemispherical, coarse wire-sieve cage (see Fig. 170): the round bottom of the cage prevents any possibility of contact with the flat bottom of the still, whilst circulation of the water and vapor takes place through the meshes; a handle serves to lift it out when the distillation is completed. Fig. 171 shows a dissected view of the still, which illustrates the relative

FIG. 170.

Wire cage.

FIG. 171.



Pharmaceutical still (sectional view).

position of the parts,—D, the still body; N, tube level; L, clamp; C, water-bath; W, condenser; B, cold-water tube; A, exit-tube for warmed water.

Fractional Distillation.—By this term is meant the process of separating by distillation liquids having different boiling-points or vapor-densities. When a mixed liquid, or one consisting of liquids of unequal volatility, is distilled, the first portion of the distillate contains a larger proportion of the most volatile constituent than of the others; hence the boiling-point is observed to rise as the distillation proceeds; and if a means is provided for collecting the distillate in several portions, or fractions, as they are called, fractional distillation offers a process by which liquids may be purified or separated. It is impossible, however, *in a single operation* to effect this separation of the component parts of a mixed liquid perfectly, because the distillate obtained at any period of the process is nearly identical with the vapor that is rising from the hot liquid, and therefore it is made up of the condensed vapor of that part of the liquid having a boiling-point at or below the temperature registered by the thermometer, plus the smaller amount of condensed vapor that is given off from the constituents having higher boiling-points, but which emit sensible vapors much below the point at which they actively boil. The relative proportions of the constituents of the mixed liquids have also a bearing in determining the composition of the distillate. By collecting the fractions carefully at stated temperatures, and redistilling each by itself, a more thorough separation may be effected, and this method is usually followed when such a separation is necessary. Upon the small scale one of the simplest forms of apparatus for fractional distillation is made by taking a gas bulb (a glass flask having a bent lateral tube in the neck), and, having adjusted a perforated cork in the neck for a thermometer, passing the tube of the gas

bulb into a loosely-stopped test-tube, which is placed in a vessel surrounded with ice or properly refrigerated. A more efficient method is to connect the lateral ascending tube of a flask with the end of a worm, or a condenser so arranged that the liquid condensed at a certain temperature may run back into the flask; vapors having lower boiling-points pass through it uncondensed until they reach the second condenser, which is refrigerated to a degree sufficient to condense all the vapor. This method is used for manufacturing purposes upon the large scale.

Destructive distillation is the process of heating dry organic matter in a distillatory apparatus until all volatile substances are driven over: the residue is said to be carbonized. Destructive distillation is a process which is rarely employed by the pharmacist; hence it is not necessary in this work to treat the subject in detail. Glass vessels are not adapted to the process, because they will not usually stand the heat required without fracture, and the solid residue frequently fuses, is insoluble in water, and becomes so firmly attached to the bottom and sides that it cannot be removed without great difficulty. The best form of apparatus is an open vessel of cast iron, like a crucible, having a flange at the top, a dome with a corresponding flange, and a bent tube for carrying off the gaseous products: the connection is made with fire-clay lute and iron clamps. The manufacture of acetic acid, succinic acid, oil of amber, etc., affords illustrations of the use of this process, which is nearly always performed on a large scale.

CHAPTER VI.

SUBLIMATION.

SUBLIMATION is the process of distilling *volatile solids*. The product is termed a *sublimate*.

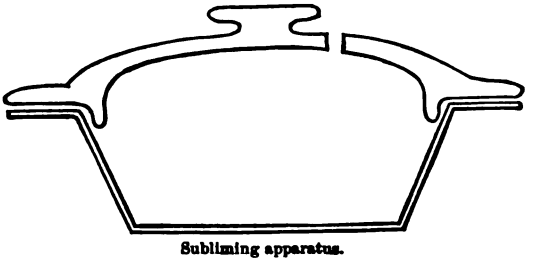
The objects of sublimation are—1, to purify volatile solids from admixed and fixed impurities, and, 2, to provide a convenient means of collecting volatile solids resulting from chemical reaction at high temperatures. The retorts or apparatus used may either be of iron, or of glass or stone-ware if the degree of heat necessary will admit of the use of the latter.

Sublimation is almost exclusively confined to operations which are conducted by manufacturers on the large scale. A process was formerly officinal for the sublimation of benzoic acid. It consisted in introducing benzoin into a shallow tinned-iron pan, and pasting over the top a sheet of filtering-paper. A pasteboard hood, shaped like a hat-box, was then fitted to the pan and tied or pasted with paper so that a tight joint was made; the apparatus was placed on an iron plate and subjected to a low but *uniform* heat: the vapors of benzoic acid passed through the pores of the filtering-paper, were separated from impurities, and, coming in contact with a cooler atmosphere in the hood, slowly condensed, often forming crystals of great beauty.

The temperature at which the condensation of the vapor is effected in sublimation has a very important influence in determining the physical character of the sublimate, and two kinds of sublimates are produced: 1. Cake sublimates. 2. Powder sublimates.

Cake Sublimates.—If the temperature of the condensing surface and of the air in contact is but slightly below that at which the volatile body is capable of subliming, the particles will be deposited in compact masses, like corrosive sublimate, commercial sal ammoniac, or carbonate of ammonia. Fig. 172 shows a simple apparatus for obtaining sublimates in cakes or masses. A shallow sheet-iron dish, having its upper edge turned out so that it forms a flat ring, is provided with an earthen-ware cover (it will be usually found more convenient to have

FIG. 172.



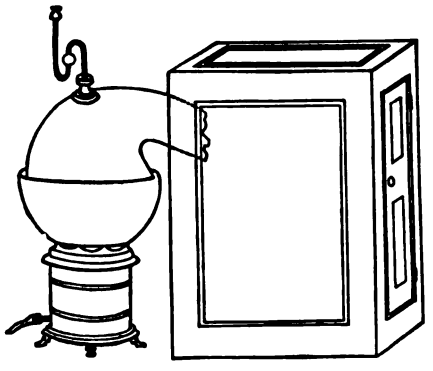
Subliming apparatus.

the iron dish made to fit the cover than the reverse), through which a hole is drilled to permit the escape of air (this may be done with a three-cornered file). After the substance which is to be sublimed has been placed in the iron dish, a piece of asbestos twine, slightly longer than the circumference of the ring, is laid upon it, and this is covered with a lute composed of equal parts of potters' clay and flaxseed-meal with sufficient water, the earthen-ware cover is pressed upon it until it adheres, and, when necessary, iron clamps are used to make a tight joint. The aperture in the cover is loosely covered with a cone of cardboard, the dish is placed in a sand-bath and gradually heated; the aperture is kept open during the sublimation by occasionally probing it with a glass rod; after cooling, the sublimate will be found adhering to the earthen-ware top in one cake or mass, and may be removed by a spatula. The earthen-ware top may be replaced by a sheet-iron one in cases in which the former would be likely to be fractured by excessive heat.

Powder Sublimates.—If the apparatus for conducting sublimation is so contrived that there is a marked difference between the temperature of the air in contact with the vapor and the subliming-point of the volatile body, the sublimate will be deposited very rapidly and in small particles, like calomel, sulphur, etc.

Fig. 173 shows a convenient apparatus for subliming camphor in powder. It is well adapted also for a lecture-room illustration of the process. A wooden case has two openings made in the sides to admit sheets of glass, which are secured in place by putty in the usual manner. One of the sides has a hinged door, which fits the frame snugly; the opposite side has a tapering circular aperture, which admits the shortened beak of a retort, as shown in the cut. Camphor is placed in the retort, a safety-tube is adjusted in the tubulure, and the retort is then placed deeply in a sand-bath on a good gas stove. Care must be observed in heating at first, and a Bunsen burner should be at hand to heat occasionally those portions of the top of the retort and the beak upon which the sublimate is forming. When the boiling-point is reached, the camphor vapor passes over rapidly, and at once falls in the form of powder upon coming in contact with the cold air in the chamber. The especial points to be observed are care in heating, and watchfulness that the beak of the retort does not become clogged with the sublimate. A judicious use of the Bunsen flame will soon melt the obstruction.

FIG. 173.



Subliming camphor.

The most important, and in practice the most difficult, part of the operation of sublimation is the regulation of the heat. The temperature of the condensing surface should always be below the fusing-point of the substance if distinct crystals or crusts are expected.

CHAPTER VII.

DESICCATION.

DESICCATION is the process of depriving solid substances of moisture, and in pharmacy should be effected at as low temperatures as possible. (See Exsiccation.)

The objects of desiccating medicinal substances are threefold: 1. To aid in their preservation. 2. To reduce their bulk. 3. To facilitate their comminution.

1. **To Aid in their Preservation.**—Chemical salts frequently contain water either chemically or mechanically combined with them. An elevation in the temperature, or the absorption of water from moisture present in the air, will in some instances cause *deliquescence*, whilst in others contact with a dry atmosphere will cause *efflorescence*, due to the evaporation of chemically-combined water; hence such salts in their natural condition are unstable; they are much more permanent when dried. Vegetable drugs soon decompose or become mouldy if allowed to remain in a moist condition, and desiccation is absolutely necessary to preserve them.

2. **To Reduce their Bulk.**—If desiccation is performed successfully, —*i.e.*, at properly-regulated temperatures under certain precautions,— the substance is merely deprived of water without suffering any loss of medicinal activity, and the reduction in bulk that follows is a practical advantage which results in adding to the strength of the medicinal substance.

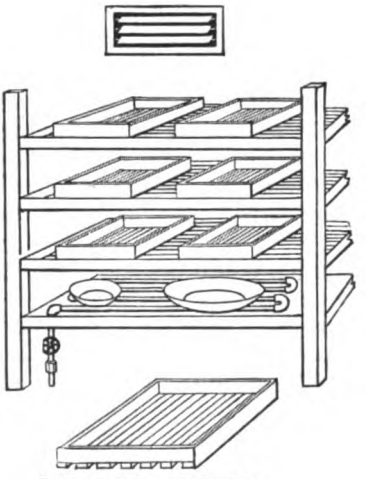
3. **To Facilitate their Comminution.**—The presence of water gives to drugs an elasticity and ability to resist disintegration, which in some cases interfere greatly with the process of bruising, grinding, or reducing the drug to particles. One of the first steps in comminution is to dry the substance thoroughly in order to make it brittle or crisp.

The apparatus employed in desiccation is frequently of the simplest character, and the heat is usually not especially created for the purpose, for it is most economical to use the waste heat from kitchen fires or cellar furnaces or the diffused heat in lofts or unused attics. There can be no objection to this if care is taken to provide protection for the substance from dust, light, and injury during desiccation. Herbs may be dried by tying them in bunches and suspending them to the attic ceiling or to the rafters of a barn during summer weather, and this is an excellent method usually, notwithstanding its slowness, because there is no danger of the heat being strong enough to cause loss of valuable volatile principles. Roots, barks, and leaves may be dried by spreading them out upon clean tables or floors in a dry room and turning them repeatedly, so as to

expose fresh surfaces to the dry air. On the large scale, and in the laboratory, special apparatus must be employed. Fig. 174 illustrates a portion of the interior of a laboratory drying-room. Live steam is passed through the pipes when higher temperatures are needed, but waste or exhaust steam from steam kettles is economically and properly used. Trays of suitable size, containing the substance to be dried placed on thin muslin, are set upon the shelves of the rack. Ventilators should be provided to carry off the moist air. The space immediately over the steam boiler can often be economically used for a drying-room by placing a sheet-iron floor over it to secure the radiated heat, and arranging racks and trays upon it in convenient positions, or by placing the drugs in barrels in which the heads have been replaced by wire netting, or by simply enclosing the drugs in coarse bags which permit the escape of moisture.

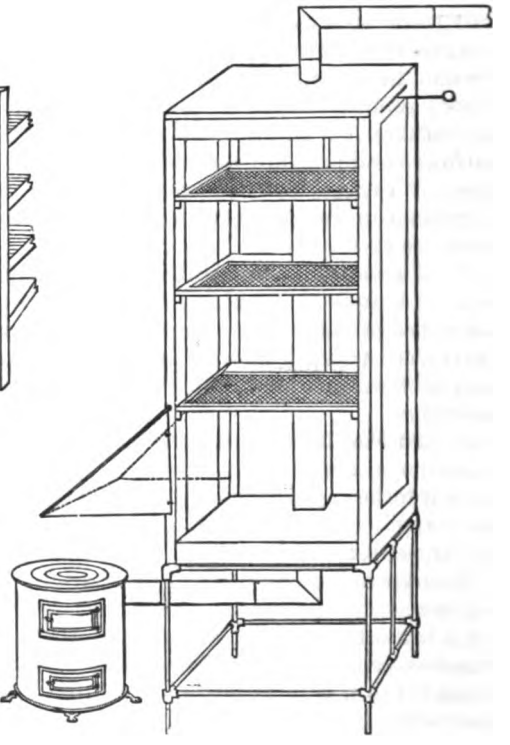
Fig. 175 shows a pharmaceutical drying closet which is simple, economical, and easily made: the heat from the flue of the pharmaceutical stove (see Fig. 53) is utilized. The frame which supports the closet is made of half-inch steam-pipe, and to the uprights the retort-rings (see Fig. 152) may be clamped, and the filtration of chilled oils in winter-time, or warm filtration or percolation of any kind, may be carried on. The sides of the closet are of thick paper, felt, or roofing-material, tacked to a wooden frame, and cleats at convenient intervals are arranged for the trays to slide upon. The stove-pipe from the stove is connected with the flue at the bottom of the drying

FIG. 174.



Desiccating frame and trays.

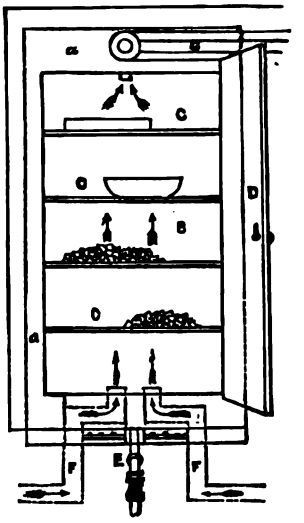
FIG. 175.



Pharmaceutical drying closet.

closet, and the heat from the smoke and gas passing up the flue is thus utilized; the hood may be dropped over the top of the stove when the latter is not needed for other purposes, the heated air carrying the moisture from the substance to be dried, rising and escaping at the ventilators. Lozenges, crystallized salts, extracts, filters, etc., may all be dried in this cheap and simple closet. One practical point about desiccation is frequently overlooked. It is that substances which are being dried must be repeatedly turned over, so that the parts underneath shall be exposed to the external dry atmosphere. In the case of salts, crystals, and other bodies, if this is not done, a hard crust is formed upon the surface which is often difficult to break up.

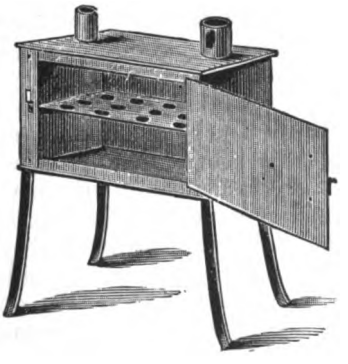
FIG. 176.



Drying closet (gas heat).

A convenient drying closet, suitable for a small laboratory, is shown in Fig. 176. It was contrived by T. Edward Greenish, of London; it is heated by gas, and is intended to fit into a recess in the wall. The drying closet, B, is made of thin sheet-iron, and provided with wire shelves, C, and a tightly-fitting door, D. The closet is made of such a size that when fixed into the recess in the wall a space of about two inches is left at the back, sides, bottom, and top, the space being covered in front by the flanges *a*, *a*; these constitute, with the door, the front of the closet. E is a gas-burner supplied from the pipe, and F, F are two air-pipes which enter at the bottom of the closet: these pipes draw their supply of air from an *external* source, and thus the laboratory fumes and odors cannot taint the substances which are to be desiccated. The upper ends of these tubes are covered with a layer of sand two inches deep, forming a sand-bath.

FIG. 177.



Drying oven.

The gas being lighted is supplied with air from the front, and the heated air, together with the products of combustion, passes around the closet through openings made for that purpose in the sides and back of the gas-chamber, up the space between the closet and the wall to a pipe, G, and thence to a chimney. The substances to be dried, or the liquids to be evaporated, are placed either upon the shelves or upon the sand-bath. The air which enters by the pipes F, F, slightly warmed by the sand, will carry up any vapor therefrom to a pipe at the top of the closet, and thence to the pipe G. In order to regulate the draught of air at the back and sides of the closet, and thereby to adjust the degree of heat, the pipe G

is provided with a circular damper, and the gas-chamber also has in front of it an arrangement for regulating the supply of air to the gas, thus preventing sudden fluctuations of temperature. By these means the heat of the closet may be readily adjusted. If the temperature of the upper shelf is 82° F., the next lower will be 85° F., the next 88° F., the lower one 92° F., whilst the sand-bath will register about 130° F.

A drying oven, intended for drying precipitates in analytical work, but very useful for desiccating small quantities of pharmaceutical substances, pills, lozenges, or drugs like squill, saffron, castile soap, etc., is shown in Fig. 177. Water is poured into the tubulure at the top, and a Bunsen burner furnishes the requisite heat when placed so that the flame touches the under surface, the legs of the oven being long enough to permit its use.

Loss in Drying Medicinal Substances.—When drugs are powdered, loss is always experienced. This arises partly from the escape of fine particles, but principally from loss of moisture in drying. Again, in powdering almost all drugs, a portion remains which resists disintegration. This is called by the miller "gruffs," and is usually worthless and should be thrown away: the gruffs are frequently kept, however, and sent with the next lot of the same drug to be ground at the mill. The dose of a powdered drug is usually somewhat less than that of the same drug before it was pulverized, because the weight it has lost generally represents inert matter, water, etc. Powdered ipecac is a good illustration of this. The active principle *emetine* resides in the starchy cortical portion of the root; the internal ligneous cord constitutes the "gruffs" of ipecac, and is inert. The exception to this is the case of those drugs containing an active volatile constituent, like the aromatics, cloves, cinnamon, nutmeg, or like asafetida, myrrh, cubeb, etc. These drugs, when powdered, generally contain less of their active constituents than they did before they were ground: the volatile oils to which their virtues are due are driven off to a greater or less extent by the amount of heat necessary to make them brittle enough to be readily pulverized. The U. S. Pharmacopœia recognizes the importance of this fact by directing myrrh, and not powdered myrrh, in the compound iron mixture; asafetida, and not powdered asafetida, in the asafetida mixture; and in the compound tincture of cardamom by the direction to mix the unpowdered drugs, cardamom, cinnamon, caraway, and cochineal together, and reduce the mixture to powder, in preference to mixing the separate powders of these drugs. If care is exercised in desiccating, the powders of most drugs possess all their medicinal properties, and in many cases they will retain indefinitely these properties unimpaired if they are properly preserved and not unduly exposed to air, light, or moisture.

The practice of some drug-millers of establishing a loss in the weight of a drug as a regular standard, and then making up the deficiency by adding the same amount of some inert substance, is reprehensible. That the amount of moisture present in different lots of the same drug varies greatly may be seen by a glance at the following table, compiled by Mr. T. J. Covell from accurate records obtained from Dr. E. R. Squibb's drug-mills. The table is valuable because it represents the loss in powdering considerable quantities of drugs:

Table showing Loss in Powdering Medicinal Substances.

Substance.	Greatest Loss per cent. on any Single Lot.	Smallest Loss per cent. on any Single Lot.	Average Loss per cent.
Acacia	1.88	0.40	0.83
Acacia (granulated)	1.67	1.03	1.35
Aloe Capensis	19.31	7.09	11.18
Aloe Socotrina	24.62	10.00	17.31
Acidum Tartaricum	2.50	0.54	1.06
Buchu	4.10	0.20	2.00
Canella	3.07	0.50	1.77
Cantharis	6.22	0.68	2.05
Cardamomum	7.10	5.00	6.02
Cassia	2.90	2.26	2.61
Catechu	1.30	0.86	1.08
Cinchona Flava	3.75	1.18	2.57
Cinchona Pallida	2.22	0.96	1.78
Cinchona Rubra	1.72	1.24	1.58
Cubeba	3.55	1.99	2.4
Ergota	5.72	0.00	3.62
Extractum Glycyrrhizæ	13.06	8.14	10.45
Gambogia	2.46	0.74	1.35
Gentiana	11.79	9.20	10.23
Gentiana (ground)	8.30	1.56	5.09
Ipecacuanha	3.66	0.64	1.91
Iris Florentina	9.00	1.10	6.22
Jalapa	12.24	2.95	9.58
Myrrha	8.81	3.59	5.80
Opium	22.85	9.91	19.61
Podophyllum	1.15	0.49	0.75
Potassii Chloras	2.70	1.52	2.01
Potassii Bitartras	1.11	0.05	0.38
Pulvis Ipecacuanhæ et Opii	1.63	0.68	1.05
Rheum	3.40	0.10	1.74
Saccharum Lactis	0.85	0.70	0.78
Sapo	18.05	11.70	15.92
Sarsaparilla (Rio Negro)	0.96	0.35	0.70
Scammonium	5.65	1.33	2.70
Scilla	16.45	10.83	13.60
Valeriana	1.51	1.45	1.48
Tragacantha	7.38	6.47	6.93
Zingiber (nigrum)	3.72	3.13	3.43
Zingiber (album)	11.74	8.57	9.70

CHAPTER VIII.

COMMINUTION.

COMMINUTION is the process of reducing drugs to particles, or breaking up their state of aggregation.

Medicinal substances in their natural state require to be mechanically divided in order to facilitate the action of menstrua or solvents, or to permit their administration *per se* in the form of fine powders.

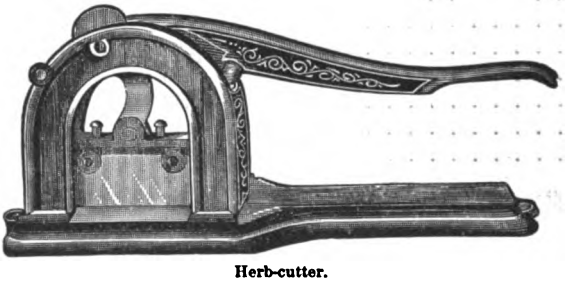
A simple illustration is offered in the case of alum. A solid lump of alum weighing one ounce, if added to a pint of water, will not dissolve nearly so quickly as will one ounce of the same alum in the same quantity of water *if finely powdered.* Vegetable substances offer very variable degrees of resistance in powdering, owing to the proportion and toughness of their ligneous fibre and the amount of cellular tissue.

Under the head of comminution will be grouped the various mechanical operations used in pharmacy by which the surface of solid substances is increased, whether by cutting, rasping, grating, chopping, crushing, rolling, stamping, grinding, powdering, triturating, levigating, elutriating, granulating, or similar processes.

By far the greater number of substances employed in medicine belong to the vegetable kingdom, and, whilst many of the processes of comminution used for these are also applicable to the chemical substances of the materia medica, it will be necessary in the following chapter to note the apparatus specially adapted to each class. . . .

Cutting, Slicing, and Chopping.—This process is used principally in bringing roots, barks, leaves, herbs, etc., to the proper condition for treating with suitable solvents. For very small operations either the pruning-knife or pruning-shears answers a good purpose. The tobacco-knife or herb-cutter shown in Fig. 178 is well adapted for the purpose. It should be observed, however, that the principle upon which a knife operates successfully should be carefully carried out in constructing apparatus designed for cutting: direct pressure without a slight drawing or sawing motion is not effective; therefore those knives which have guides arranged

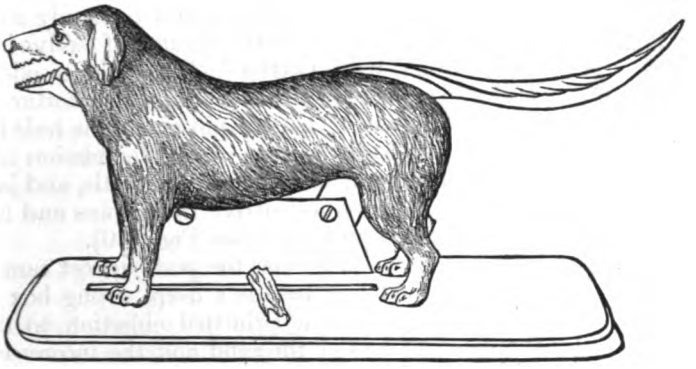
FIG. 178.



Herb-cutter.

so that the knife-edge sunders the particles at an angle are greatly preferred. Fig. 179 exhibits a combination root-cutter and cork-press which is an interesting object for the dispensing counter. The handle or lever is the dog's tail; this, if elevated, raises the cutter, and at the same

FIG. 179.



Combination root-cutter.

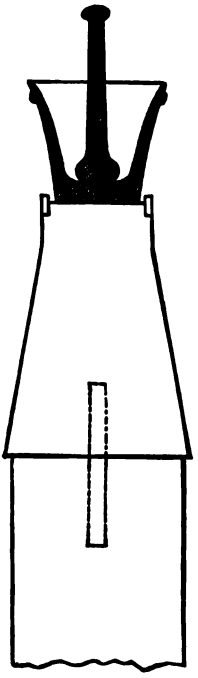
time opens the jaws of the dog. Upon the large scale drugs are cut with hay-cutters, implements well known to the farmer, and usually consisting of four or more circular blades fastened to a shaft and revolving at the end of a trough, down which the substance that is to be cut is gradually fed. Sarsaparilla root is cut in this way before it is contused.

Rasping or Grating.—A half-round rasp (see Fig. 137) or a nutmeg-grater is very useful at the prescription counter, as it frequently enables the pharmacist to prepare a small quantity of a powder for a prescription in case the regular stock-bottle is found empty or a very fresh powder is needed. The small pocket pepper-mills used by European travellers for grinding whole pepper at the table will be found especially useful.

Contusion, or bruising, is an operation very frequently resorted to. It may be defined as the process of reducing a drug to particles by striking it a succession of blows. The instrument generally employed is the well-known mortar and pestle, which, for contusing drugs, should be made of cast iron, bell-metal, or brass. The shape best adapted for this purpose is shown in Fig. 180, the mortar being represented on a mortar-block. The bottom of the mortar should be flat and heavy, so that it may rest firmly upon whatever base it is placed; the sides should flare slightly, but the mortar should be so deep that substances will not be easily forced out on to the floor by the blows of the pestle. A leather or wooden cover should be used upon the mortar when corrosive or irritating substances are contused. The pestle should be heavy and sufficiently flat on the under surface to permit the convexity nearly to coincide with the concave surface of the mortar. The inner surface of the mortar should be tinned, to prevent rusting and facilitate cleaning. The best support for an iron mortar is the top surface of a hard-wood post six inches in diameter and of sufficient length to pass from the top

of the floor into the cellar and rest on the ground. A turned wood mortar-block two feet high should rest upon the post; this block should have a flat iron hoop upon the top projecting half an inch above the surface, as suggested by Dr. H. T. Cummings, whilst the bottom should have an inch hole bored up through the centre for the distance of twelve inches; an inch wooden pin, two feet long, should be firmly fixed in the centre of the post for the distance of twelve inches, which would leave twelve inches of the wooden pin projecting above the floor. Now, if the mortar-block is placed over it so that the pin enters the hole in the base, it will be found that a solid foundation is provided for resisting the blows of the pestle, and jarring and vibration, so destructive to balances and fragile apparatus, are prevented (see Fig. 180).

Fig. 180.



Mortar and pestle.

When for good reasons the post-support cannot be used, the next best base is a deep, strong box filled with dry sand. The principal objection to this is the constant loss of the sand and the inconvenience of having it spilled on the floor. When it is necessary to use an iron mortar and pestle for a continuous operation, for a considerable length of time, it will be found advantageous to connect the upper part of the pestle with an elastic wooden spring attached to the ceiling, so that the labor of lifting the pestle will be lessened. This spring is preferably made from a tapering hickory strip seven or eight feet long and four inches wide at the base, the rope connecting the pestle with the end of the spring being of such length that the pestle barely touches the bottom of the mortar when the spring is stretched to its utmost tension. On account of the large number of mills scattered over the country, established for grinding drugs, and the increase of facilities for grinding and powdering drugs on the large scale, the skilful use of the mortar and pestle by the pharmacist must be regarded as a lost art. The necessity for thoroughly drying drugs before subjecting them to comminution has already been mentioned. (See Desiccation.)

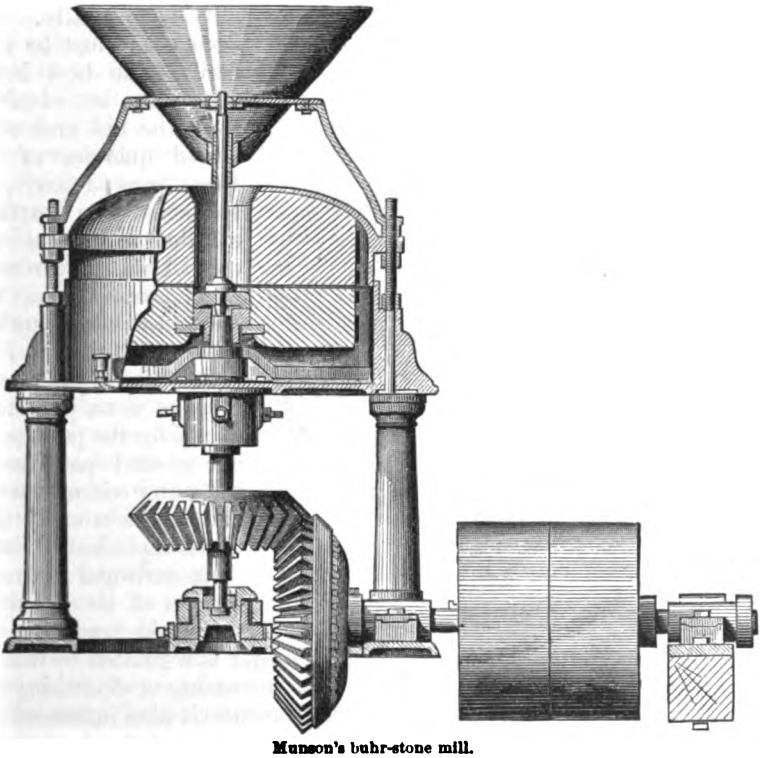
Wooden mortars and pestles are occasionally used for contusing soft bodies, like prune pulp, almonds, recent fleshy roots, substances that are affected by iron, etc. Lignum-vitæ is a very hard and suitable wood for this purpose, although boxwood is preferable when it can be procured, because it has less tendency to split.

Marble mortars are also used for operations of a similar character on a somewhat larger scale; but care must be used to avoid putting substances containing acid into such mortars, on account of the reaction upon the marble and the consequent contamination of the product.

Grinding and Pulverizing.—The former term is applied to the reduction of a substance by mechanical means to *coarse* particles, the latter to the production of *fine* particles. These processes are the most important of any grouped under comminution. At present they are

very largely carried on by drug-millers. It is necessary for the pharmacist to be familiar with the methods employed, however, if intelligent judgment is to be exercised in the subsequent treatment of the vegetable and mineral substances of the materia medica. Before pulverizing a substance it must be dried, and the desired fineness of the powder determines the character of the preliminary treatment. In order properly to grind or powder substances upon the large scale, special knowledge and experience are required; previous acquaintance with the methods best suited to accomplish the object on the small scale, whilst useful to some extent, will be found inadequate. If a drug is to be coarsely ground, the necessity for thoroughly drying it is generally not so pressing as when a fine powder is to be made of the substance; drugs containing volatile oils are apt to be rendered worthless if they are dried sufficiently to enable them to be ground to a fine powder. Myrrh,

FIG. 181.



Munson's buhr-stone mill.

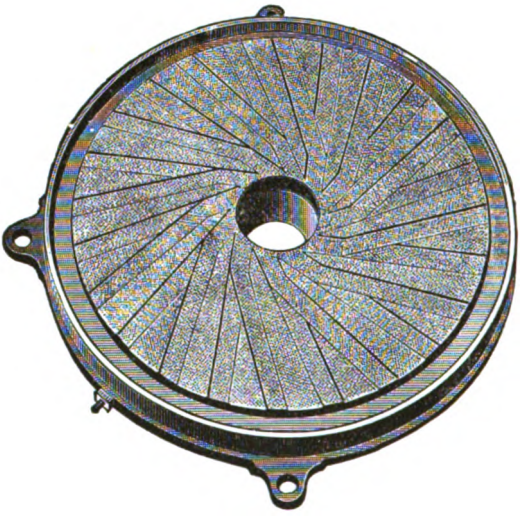
cloves, cubebs, nutmegs, etc., afford good illustrations of this: hence these drugs are preferred when coarsely powdered. Within the last few years an important change in pharmaceutical practice in this respect has been effected, and preparations in which formerly very fine powders were directed are now ordered to be made from coarse powders: the processes for extracting the soluble principles having been greatly improved, the

necessity no longer exists for using the very fine powders, and hence volatile principles are not sacrificed.

DRUG-MILLS.

The Buhr-stone Mill is very extensively employed in drug-milling. There are two kinds, termed respectively under-runners and upper-runners. The principle upon which this mill operates is that of reducing the substance to particles by the friction and contusion that follow the delivery of the substance in the contracted space formed by a rapidly-revolving stone disk, brought in nearly close contact with a similar disk which is stationary. In the under-runners the upper stone is stationary and the lower stone revolves, the upper stone having a central circular opening through which the substance is fed, as shown in Fig. 181, the under stone being connected with the shaft. In the upper-runners the lower stone is stationary, the upper stone being perforated as in the under-runners. In both, the stones revolve horizontally. The stone used must be very hard. The best buhr-millstone is obtained from the old and celebrated quarries of La Ferté-sous-Jouarre, in France. The surfaces of the millstones are crossed with "furrows," which pass from the centre to the circumference, as shown in Fig. 182. The object of the furrows is to provide a means for the passage of the ground particles to the outer circumference and to the trough: this is accomplished through the centrifugal force and current of air caused by the rapid revolution of the stone in motion. The fineness of the powder is regulated by raising or lowering one of the stones, this of course increasing or decreasing the space between them; the character of the powder is also influenced by the dressing of the stone. Fig. 181 illustrates one of the best of the modern buhr-stone mills,—Munson's under-runner.

Fig. 182.

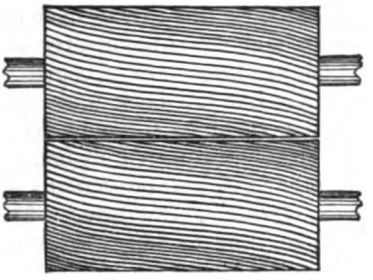


Buhr-stone.

Roller-Mills operate by crushing, or crushing and cutting, the substance. In their simplest form they consist of two smooth-faced iron rollers revolving in opposite directions, which can be brought into close contact by regulating screws. The principle has been extended and improved in modern milling, so that for grinding certain drugs this mill gives excellent results. The rollers are now made of steel, chilled iron,

or biscuit (porcelain), and are corrugated or ribbed to suit special purposes. The sections of these corrugations are serrated, undulated, or crenated. The rollers revolve in the same direction or in opposite directions, and at equal or different speeds. Fig. 183 shows the position of the grooved rollers, and Fig. 184 shows a sectional view of the same. A roller drug-mill, operated by steam-power or by hand, is made by W. Schroeder & Co., of Leipsic, Germany. The rollers have sharp oblique furrows upon their surfaces, and extra rollers are supplied to suit special purposes for grinding very fine powders, etc. (N. R., 1878, p. 336.) Allaire, Woodward & Co., of Peoria, Illinois, use with great success a corrugated roller-mill in grinding nux vomica.

Fig. 183.



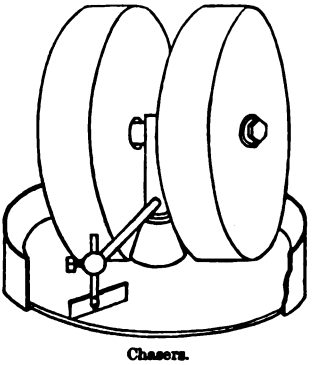
Grooved rollers.

Fig. 184.

Grooved rollers (cross-section).

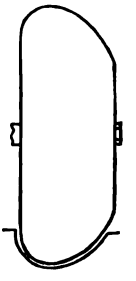
Chaser-Mills are so called because two heavy granite stones, mounted like wheels and connected by a short horizontal shaft, are made to revolve or *chase* each other upon a granite base (see Fig. 185). The stones are discoid, and the grinding surfaces are the circumferential edges of the stones and the surface of the granite base; an iron cylinder, called a "curb," surrounds the circular base, and a "scraper," made of iron and adjusted at an angle, is connected with the shaft. It is evident that if the substance to be powdered is delivered upon the granite base in the path of the rapidly-revolving stones it must speedily be reduced to powder, not only on account of the crushing weight of the heavy stones, but also because of the attrition caused by the outer edge of the stone travelling through a longer distance than the inner edge. In some mills the stones having flat, grinding surfaces have been replaced by stones having curved surfaces, and the flat base by a circular gutter curved to correspond with that of the surface of the stone: in this way the grinding surfaces have been greatly increased and rapid pulverization facilitated. Fig. 186 shows the shape of the stones of this form in use in Dr. Squibb's laboratory. In practice the chasers are enclosed in a tight box or small room, closed with air-tight doors, and the substance to be powdered is fed in from the top by an

Fig. 185.



Chasers.

Fig. 186.



Chasers (curved grinding surface).

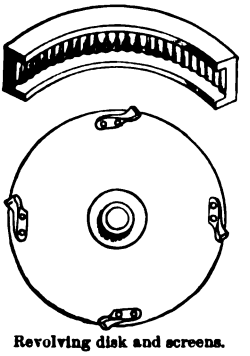
elongated funnel, the spout of which delivers the material immediately upon the path of the stones. The height of the curb is increased by pasting heavy paper around it, and the fineness of the powder is influenced by the height of the curb. The revolution of the chasers produces an upward current of air; this carries over the lighter particles, which fall outside the curb and are subsequently collected as a fine powder; those particles which are larger are of course heavier and cannot rise to the height of the curb, but fall back under the stones to be reground: in this way refractory substances can be reduced to very fine powder. Chasers are more largely employed in making "dusted" or very fine powders than any other form of pulverizing apparatus.

Mills with Iron Grinding Surfaces.—Many mills have been constructed from time to time to suit special purposes: these cannot be noticed at length in a work having the scope of the present one. *Barrel-mills* have been used. These consist of strong barrels lined with sheet-iron, supported by strong iron shafts attached to the heads. The substance to be comminuted is placed in the barrel, and large round iron balls, like cannon-balls, are introduced: upon revolving the barrel rapidly, disintegration is effected. This principle is used also in pulverizing dried extracts and friable substances. A hollow circular iron ring, having a diameter slightly larger than that of the cannon-ball which is placed inside with the charge of substance to be powdered, is made to revolve rapidly; the inertia of the cannon-ball and the friction render its speed less than that of the ring, and the substance is quickly ground. The "Bogardus" mill is constructed on a very ingenious principle: the grinding surfaces are two horizontal chilled-iron plates, the lower one revolving, the upper one stationary; both have corrugations having sharp edges, arranged concentrically. The peculiarity of this mill is that the centres of the grinding-plates are not directly over each other as in buhr-stone mills, but the centre of the lower plate is placed a few inches to one side: by this arrangement the substance to be ground is caught by the ring-edges of the revolving plate and dashed against the cutting-edges of the stationary upper plate at an angle, the effect being to incise it as if cut with scissors and crush it at the same time.

Mead's Disintegrator differs from the mills thus far considered in the principle of construction, in the character of the grinding surfaces, and in its method of operation. The grinding is effected by hardened steel beaters riveted to a steel disk, which revolves vertically between corrugated rings; the beaters are placed on the side of the disk nearest to the feeding-trough, and catch the material as it enters the mill, beating it with great force against the corrugated rings until it is fine enough to pass between the disk and the face of the rings; as soon as it passes here, it is on the side of the mill from whence it is discharged, and all that is fine enough is immediately driven out by the beaters on the back of the disk. That portion of the substance which is not fine enough is caught by the beaters and beaten against the screens until sufficiently fine to pass through. The screens are two inches in width, and extend around three-fourths of the diameter of the mill: they are made of square steel bars, and present a grinding surface to the beaters,

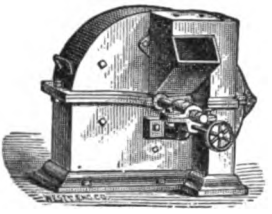
but there is sufficient space between them to permit the passage of fine particles. The substance, as it is ground, falls into a receiving-box below the mill, or is discharged through the floor into a room below. One prime requisite in running this mill is high speed: the disk must make three thousand revolutions a minute. The disintegrator is capable of grinding one hundred and fifty pounds of Ignatia bean, or six hundred pounds of wild-cherry bark, in one hour. Fig. 187 gives an illustration of the mill, whilst Fig. 188 shows an enlarged view of the revolving disk, and a section of the screens immediately above.

FIG. 188.



Revolving disk and screens.

FIG. 187.



Mead's disintegrator.

Hand-Mills.—It is more difficult to construct a drug-mill for the general use of the pharmacist than one for the special purposes of a drug-miller. The latter has the choice of a buhr-stone mill, chaser, disintegrator, iron mill, etc., which he can adjust to suit the character of the substance he desires to grind. The pharmacist's drug-mill, on the other hand, is expected to do all kinds of work rapidly and well. It must, therefore, be capable of ready adjustment, possess durability, and have cutting surfaces not quickly dulled, and working parts not liable to get out of order.

It is not easy to realize that every medicinal substance has an individuality of its own, but he who neglects the study of the physical characters of the substances of the materia medica can never expect to overcome successfully the obstacles which stand in the way of disintegration. Hand drug-mills may be divided into three classes: 1. Those having vertical grinding surfaces. 2. Those having horizontal grinding surfaces. 3. Those having conical grinding surfaces. They have the following points in common: iron is the principal material of construction, the grinding surfaces are of hardened iron or steel and consist of teeth arranged in concentric rows, and the regulation of the fineness of the powder is effected by a screw or screws, by which the plates are made to approach or recede from each other.

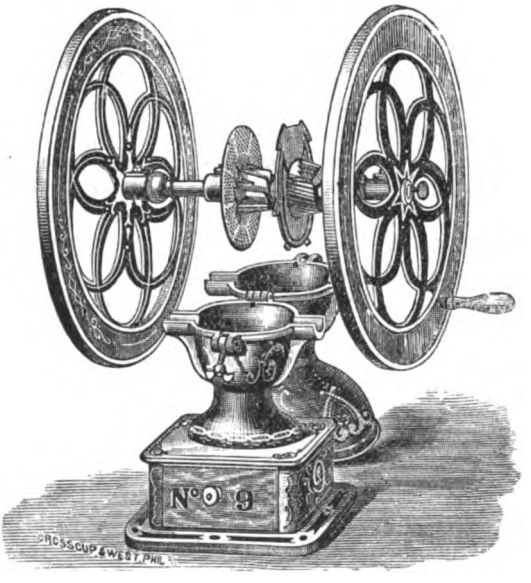
1. HAND DRUG-MILLS WITH VERTICAL GRINDING SURFACES.—*Swift's Mill* (old style).—This hand-mill has been in use longer than any other in the American market. Its introduction marked an era in the history of pharmacy, and, although superseded now by greatly-improved mills, it is still remembered with grateful feelings by those of the present generation, who had been previously accustomed to laborious mortar practice. In this mill there are two vertical grinding-plates, one of which is stationary, whilst the other is connected with the horizontal revolving shaft; a conical breaker is also attached to the shaft, and when in position it is immediately below the lower opening of the hopper; a fly-wheel with a handle is bolted to the outer

end of the horizontal shaft, and furnishes the power required. The teeth are of iron and arranged in concentric rows, and the plates are made to approach each other or to separate by an adjusting-screw. The supports of the mill are of ash or oak, and are durable and firm. The principal disadvantages of this mill are the difficulty of cleaning it, its slow action, its liability to become clogged, and the absence of a tight box or drawer to receive the ground drug. Two improvements have been made in the Swift's new-style mills: in one the fly-wheel has been made larger and heavier, in the other a double fly-wheel has been attached.

Troemner's Mill, whilst constructed upon the same principle as Swift's, is much more thorough in its action, and requires less labor to operate it, than Swift's mill (old style). It has vertical plates, a thumb-screw to regulate the fineness of the powder, a heavy fly-wheel, and a close-fitting drawer to receive the powdered drug. It is not so easily cleaned, however, as the next mill to be mentioned.

The Enterprise Mill.—The introduction of this mill, in 1875, gave an impetus to the manufacture of hand drug-mills which is still felt: the application of several new principles, and the extension and improvement of some valuable old ones, at once gained the attention of practical pharmacists. The great advantage possessed by this mill over those in the market at the time it was introduced was the ease with which the interior and the working parts could be reached. The principle of supporting the grinding-plates upon a horizontal shaft, to the extremities of which heavy fly-wheels were attached, and providing a means for lifting all the working parts out of the interior to facilitate their cleaning, were novel features. Fig. 189 so thoroughly illustrates this mill that it is hardly necessary to dwell upon its other features. The left-hand grinding-plate revolves, being geared to the shaft, whilst the one on the right hand is stationary: when in position for grinding they are, of course, nearly in contact. The opening of the interior is effected by simply turning the thumb-screw in front. A smaller mill is shown in Fig. 190. It is very conveniently used at the dispensing counter.

FIG. 189.



Enterprise drug-mill.

2. HAND DRUG-MILLS HAVING HORIZONTAL GRINDING SURFACES.—*Thomas's Mill.*—This was one of the first hand drug-mills

made upon this principle. There are two horizontal grinding-plates, the lower one revolving and the upper one stationary. A vertical shaft, which is geared to a horizontal shaft by bevel-wheels, communicates the power to the lower plate upon revolving the fly-wheel. The absence of a closed receptacle, and the difficulty of quickly cleaning the grinding surfaces, are the principal objections to this mill.

FIG. 190.

Drug-mill (dispensing).

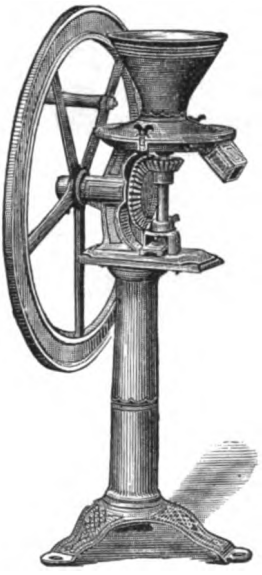
Swift's B Mill.—This is a comparatively new mill, very different in appearance from the old Swift's mill, and different in principle. The grinding-plates are horizontal, the lower one revolving, whilst the upper one is stationary and forms the lower part of the hopper. It has two fly-wheels, but the receptacle for the powder is an open one. A valuable feature of the Enterprise mill is present here,—*i.e.*, that of opening horizontally in the centre. The fineness of the powder is regulated by raising or lowering the lower plate by the thumb-screw.

3. HAND DRUG-MILLS HAVING CONICAL GRINDING SURFACES.—The principle of construction in these mills is probably the best, because it avoids the fault of those constructed on the vertical-plate principle, that of permitting particles to drop into the receptacle before they are finely ground, and also the fault of the horizontal-plate mills, which may hold the ground particles too long, often until clogging results. The conical-plate mill, if properly constructed, leaves little to be desired.

Hance's Mill is made on this principle. Formerly, the objection to this mill was the loss of time and labor consumed in getting it apart: this has been obviated by the introduction of the principle of opening it horizontally with the same kind of thumb-screw and hinge that is used in the Enterprise mill. The Hance mill is better adapted for heavy work than any other of the hand drug-mills, and, if desired, a belt and pulley can be attached for steam-power. The lower plate is conical in shape, the summit being elongated into a breaker; the teeth are arranged in consecutive rows, a scraper being attached to the under surface of the lower plate; the upper grinding surface is situated upon the lower surface of the hopper, and corresponds in shape and in the arrangement, number, and size of teeth with the surface of the lower plate. The revolving-plate is attached to the upright shaft by a simple key; this permits the easy removal of the plate when the mill is to be cleaned, yet holds it securely when in operation. Power is communicated by means of two shafts at right angles, geared with bevel cog-wheels. The fineness of the powder is regulated by a thumb-screw at the base, which elevates the revolving-plate. The support to the mill is a strong iron frame, which is cast in one piece, and, although the mill has but a single fly-wheel, this is partially compensated for by the length of the bearing for the horizontal shaft. Fig. 191 shows the

form which is mounted on a stand and is designed to be bolted to the floor; the new form, in which the mill is mounted on a box-stand, may be preferred by some. Fig. 192 shows the upper grinding-plate, and Fig. 193 the lower plate with a feeder, which is fastened to the upper portion with a set-screw, so that seeds and similar drugs may be automatically fed to the mill.

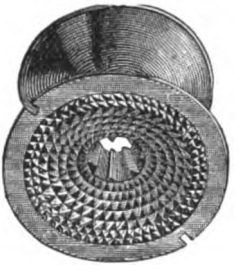
Fig. 191.



Hance's drug-mill.

General Rules for Operating Hand-Mills.—Much of the dissatisfaction experienced in operating hand-mills has arisen from improper methods of using them, or from failure to measure accurately the degree of resistance to disin-

Fig. 192.



Hance's mill (upper plate).

Fig. 193.

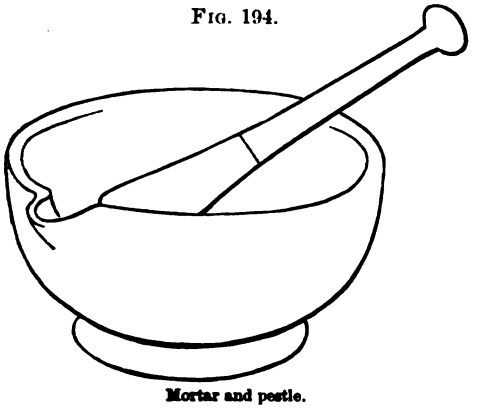
Hance's mill (lower plate).

tegration possessed by the substance to be ground. One of the first requisites, as before mentioned, is to dry the substance as perfectly as its physical character will permit without injuring it. If coarse, bulky, fibrous roots, barks, or similar substances are to be ground, they must first be cut or bruised. Most substances are ground with less labor if they are passed through the mill first with the coarse adjustment, returning the portion which is sifted out for regrinding, after setting the plates more closely together: this plan is repeated until the whole is ground. Care should be taken not to feed the substance into the hopper faster than it can be ground. The desire to get through quickly is the most frequent cause of clogging the mill, and when this occurs much time is lost, and the operator is strongly reminded of the well-worn proverb about undue haste. If a considerable quantity is to be ground, two persons can operate the mill more economically than one,—one feeding the mill carefully, the other supplying the physical labor, and, after the expiration of a given time, exchanging places. Good judgment is necessary in determining the rapidity with which substances can be fed into the hopper. Resinous or oily drugs, or substances which soften by heat, require very careful treatment and cannot be fed rapidly; dry ligneous barks or roots, on the other hand, can be fed as rapidly as the extent of grinding surface of the mill and the muscle of the operator will permit. The mill should be thoroughly cleaned after each operation, particular attention being given to the grinding-plates. In the case of substances which form hard lumps by heating or clogging upon the plates, the quickest way is to use boiling

water to soften or dissolve the lumps; the plates should then be quickly dried, to prevent rusting. By running sawdust or rice chaff through a mill, after an odorous drug has been ground, it may be speedily cleaned and freed from odor.

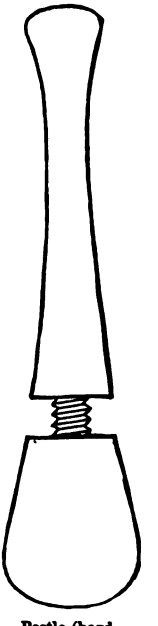
Trituration is the process of reducing substances to fine particles by rubbing them in a mortar with a pestle. The pestle is given a circular motion, accompanied by downward pressure, and the most effective method of using the pestle is to begin in the centre of the mortar and describe a circle of small diameter with the pestle on the substance, and gradually increase the size of the circle with each revolution until the side of the mortar is touched, when the motion is reversed and circles continually smaller in diameter are described until the centre is reached: this is repeated until pulverization is effected: by this treatment all the particles are brought under the action of the pestle. The mortar and pestle best adapted for this operation have the shapes shown in Fig. 194. Mortars with pestles having flattened ends are the best. Wedgwood-ware is very serviceable, but is difficult to keep clean. As triturating mortars are rarely subjected to blows, porcelain mortars of proper shape are preferred. One of the principal annoyances in the use of wedgwood or porcelain mortars and pestles is that of the continual loosening of the handle of the pestle. The cement employed by the manufacturer is chiefly rosin of bad quality, and in using the pestle the particles of loosened cement often drop into the mixture in the mortar during trituration. The best plan is to pull the handle out of the pestle entirely as soon as possible and reset it: this is easily done by heating the end of the pestle in a sand-bath until the cement has softened so that the handle may be extracted, then some hot cement (good sealing-wax) is poured into the pestle-hole, and the wooden handle is at once pressed forcibly in and held in its place by wedging or other means until the sealing-wax has hardened. The hard-rubber handle, which is made to screw accurately into the pestle (see Fig. 195), is a great improvement over the ordinary

FIG. 194.



Mortar and pestle.

FIG. 195.



Pestle (hard-rubber handle).

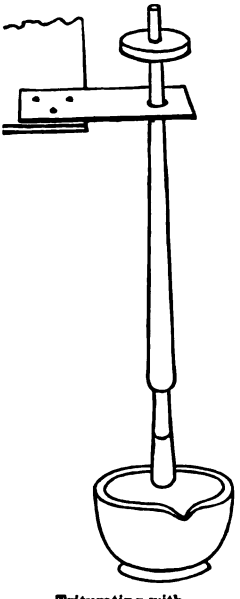
handle, and the additional cost is more than repaid by the comfort of using it. Where trituration is combined with contusion, as frequently happens in effecting solutions of chemical substances, a wedgwood mortar of the shape shown in Fig. 196 is well suited for the purpose. The selection of good mortars and pestles is frequently overlooked amidst the many items of detail in furnishing a pharmacy; but few implements bring more satisfaction to the operator than good mortars and pestles. It is a safe rule to examine every purchase carefully before accepting it finally, to see whether the pestle fits the mortar accurately: it should have as much bearing on the interior surface of the mortar as its size will permit, because the rapidity of the trituration depends largely on the amount of contact of the surfaces.

FIG. 196.

Wedgwood mortar and pestle.

The use of a round-surfaced pestle in a flat-surfaced mortar is just as great a waste of labor as that of a flat-surfaced pestle in a round-surfaced mortar. Trituration, as a distinct method of preparing a class of preparations, was officinally recognized in the U. S. Pharmacopœia of 1880, and a new preparation, *Trituratio Elaterini*, made by triturating elaterin with sugar of milk, was introduced.

FIG. 197.



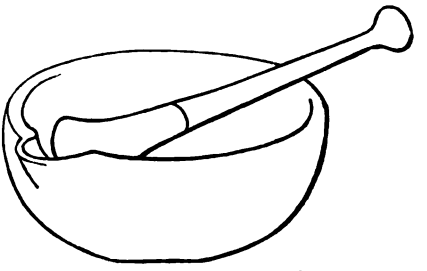
Triturating with loaded pestle.

Fig. 197 shows a device for facilitating trituration. It was communicated by Charles Rice, and is simpler and more effective than similar contrivances which have been described. It consists of an ordinary mortar and pestle, the latter having been lengthened by cutting down the mushroom top of the handle, so as to admit of its being inserted into the large end of a wooden handle, shaped somewhat like a ball-club, and between two and three feet long. The upper end of this handle should be about an inch in diameter, and during the use of the pestle is to be kept upright and steady by passing through an opening in a piece of heavy pasteboard or wood which may be tacked to the under side of some convenient shelf. The mortar should stand on a counter about three feet from the floor, and the upper end of the pestle pass through a shelf above. To stop the noise caused by the pestle striking against the sides of the opening, a piece of sole-leather is attached to the under side of the shelf and the pestle passed through a hole in its centre. This also serves

another purpose; viz., when it is necessary to raise the pestle to admit of changing or stirring the contents of the mortar, the leather will clasp the enlargement of the handle so as to suspend the pestle securely out of the way of the hands. In using the apparatus, one hand grasps the handle just above its lower end, and a very slight effort is requisite to give it the necessary motion. The weight of the handle is usually sufficient to insure a proper degree of friction. If, however, more pressure is desired, the pestle can be weighted by slipping a perforated weight on to an iron pin driven in the top of the handle.

Mortars and pestles are sometimes made of green or white glass. The former are to be preferred because they are stronger; the latter, however, present a handsomer appearance. Glass mortars are not adapted to the continued trituration of hard substances. They are useful only in dissolving certain chemical substances directed in prescriptions, like corrosive sublimate, the alkaloids, etc. It is best to place the glass mortar over a dark surface, in order to show by contrast more clearly when the solution of the white object is effected.

FIG. 198.



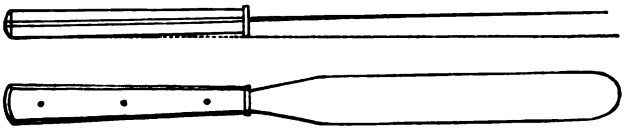
Porcelain mortar and pestle.

Porcelain mortars and pestles (see Fig. 198) are, however, more generally useful as solution mortars. Pestles entirely of porcelain are objectionable, because they are so easily broken.

Spatulas.—The process of trituration as ordinarily performed requires the use of spatulas. These consist of flexible steel blades attached to handles, and in trituration they serve to loosen the substance as it becomes packed upon the sides of the mortar. Spatulas are largely used in extemporaneous pharmacy, and they will be alluded to frequently under various special heads in Part VII. The blade of a spatula is frequently broken when too much pressure is applied, but if the broken blade remaining in the handle have its sharp corners ground off upon a grindstone, or filed off, it will be just as useful for some purposes as it was when perfect.

Spatulas may now be had of excellent quality, and greatly improved in style over those formerly used. The best form is the balance-handled spatula (see Fig. 199). In this the metal of the handle and that of the

FIG. 199.



Balance-handled spatula.

blade are continuous and of the same width, so that the annoyance of the tang becoming loose in the handle, as in the old-style spatulas, is avoided. The flat metal handle is enlarged by riveting smooth, flat pieces of hard

wood to it to insure convenience in using. The balance-handle derives its name from the fact that when lying upon the counter the weight of the handle is sufficient to overcome the weight of the blade, so that contact of the blade with the counter is prevented. Solid-handled spatulas (see Fig. 200) are also made, the whole being of one solid piece

FIG. 200.

Solid-handled spatula.

of metal, and the handle being nickel-plated. A pocket spatula, which closes like a clasp-knife, is also furnished by dealers.

Fig. 201 shows a spatula made entirely of horn, and shaped like a

FIG. 201.

Horn spatula, with handle.

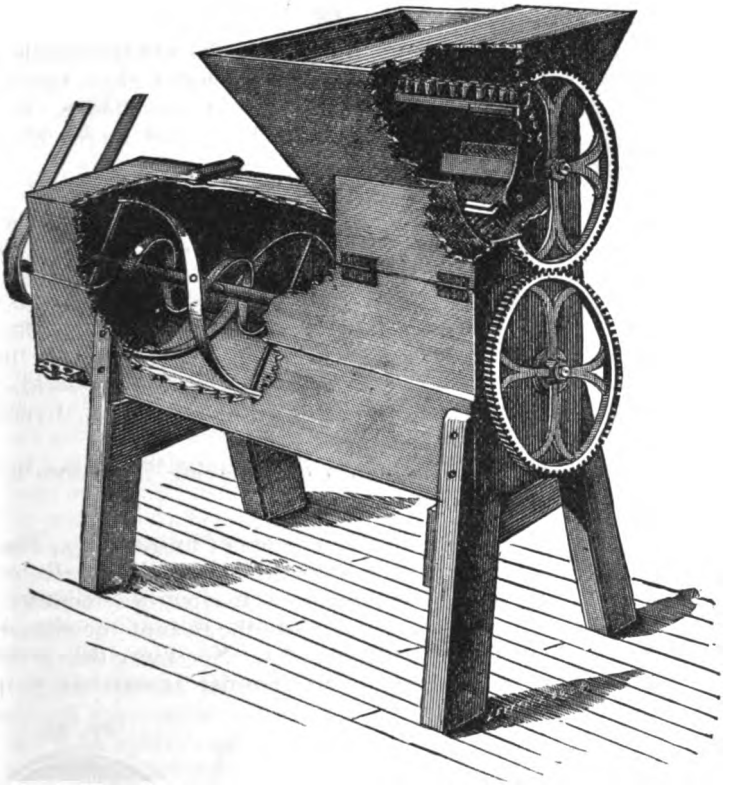
steel spatula, for making ointments which contain corrosive substances, or substances acting on steel.

Sifting is the process of passing a powdered substance through the meshes of perforated material with the object of separating the coarser from the finer particles. Sieves are employed in this process: the frames are usually round, although sometimes they are oval, square, or rectangular. The ordinary sieve is usually made by stretching wire gauze over a flat wooden ring, and keeping it in its place by slipping over it a narrow wooden ring of slightly greater diameter, which is tacked securely. Covered sieves, or drum sieves, have tight covers for the top and bottom. The simplest pharmaceutical sieve for general use is obtained by making five rectangular frames, each four inches deep, ten inches wide, and sixteen inches long. These should be light but strong, and the bottoms covered with brass-wire gauze of different degrees of fineness. A box, ten inches deep, twelve inches wide, and twenty-two inches long, with a tight cover, is provided to hold the sieves and prevent dust from escaping. Two cleats are nailed horizontally upon the sides of the box, five inches from the top, for the sieve to slide upon, and a hole is cut in the front of the box in order to permit a handle, with a hook at the end, to pass through and be attached to a screw-eye in the front side of the sieve; two large corks are screwed to the back of the sieve at either end to act as buffers. The powdered substance is introduced into the proper sieve, which is placed upon the cleats, and the handle passed through the hole and hooked to the sieve; the cover is then placed in position, and the sieve pushed backward and forward, touching the back lightly.

A very important point, which must not be omitted after sifting substances, is the thorough mixing of all portions of the sifted powder, in order that each part of the finished powder may have a uniform composition. The starchy portions of a drug will be powdered more

quickly than the ligneous portions, and will usually pass through the sieve first: hence the sifted powder must always be thoroughly mixed. Upon the small scale this may be easily effected with a spatula or mortar and pestle; upon a larger scale special apparatus is needed. Hunter's sifter is one of the most effective: it is shown in Fig. 202. In this the powder is sifted in the cylindrical sieve, and adhering particles or small lumps are brushed through by the revolving

FIG. 202.

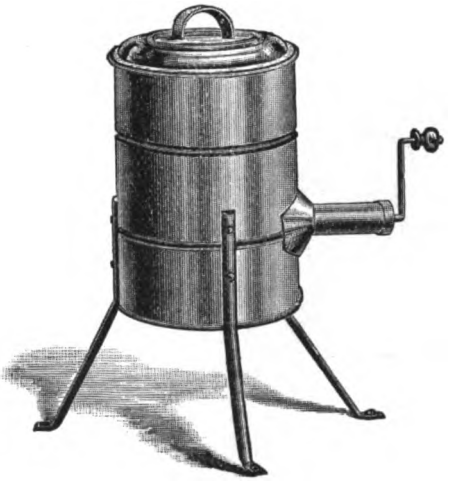


Hunter's sifter.

brushes; the revolving spiral mixers in the large box cause the particles to be thoroughly mingled. The illustration shows the method of operating so well that further description is unnecessary. In Fig. 203 is seen an enclosed sifter well adapted for many purposes, whilst Fig. 204 shows a sectional view of the same kind of sifter for smaller operations. The sieve is hemispherical in shape, and is contained in a tinned-iron scoop (see Fig. 205, which shows the end view). Two circles of stout wire are soldered to a central axis at right angles to each other, and the axis passes through the tin handle and terminates in a crank. When a powder is placed in the scoop, and the wire rings are made to revolve by turning the axis with the hand, the particles of powder are

rapidly forced through the meshes of the sieve. This apparatus is especially useful in breaking up moistened lumps in powders which are about to be percolated. (See Percolation.)

FIG. 203.



Sifter.

The degree of fineness of powders is designated in the United States Pharmacopœia by the number of meshes to the inch possessed by the sieve. The five different sizes are as follows:

Very fine powder should pass through a sieve having 80 or more meshes to the linear inch = *No.* 80 *powder.*

Fine powder should pass through a sieve having 60 meshes to the linear inch = *No.* 60 *powder.*

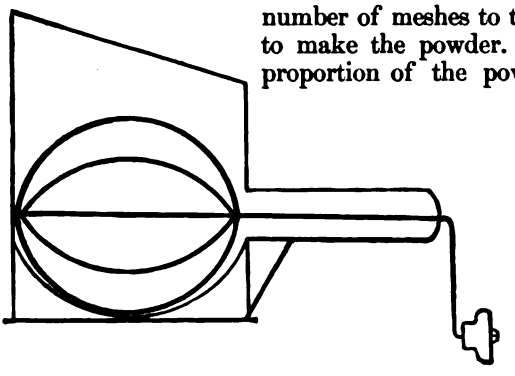
Moderately fine powder should pass through a sieve having 50 meshes to the linear inch = *No.* 50 *powder.*

Moderately coarse powder should pass through a sieve having 40 meshes to the linear inch = *No.* 40 *powder.*

Coarse powder should pass through a sieve having 20 meshes to the linear inch = *No.* 20 *powder.*

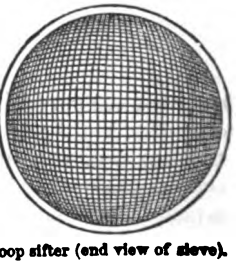
In special cases powders of different degrees of fineness (*e.g.*, No. 30, No. 12) are directed to be taken. In every case the number of the powder indicates the number of meshes to the inch of the sieve used to make the powder. Not more than a small proportion of the powder is expected to pass

FIG. 204.



Scoop sifter.

FIG. 205.



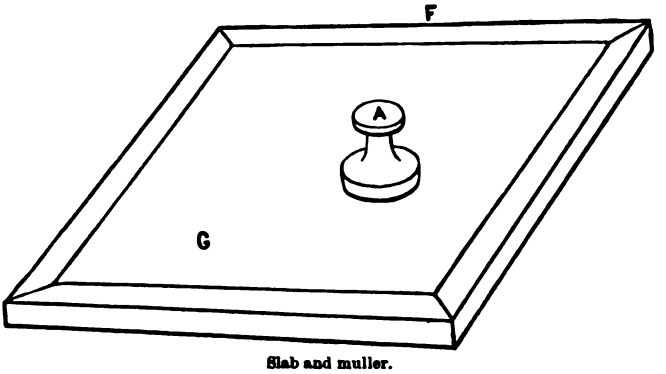
Scoop sifter (end view of sieve).

through a sieve having ten more meshes to the inch than the one designated.

For very fine powders, bolting-cloth is used for the sifting medium; and when acid substances are to be sifted, horse-hair sieves are used.

Levigation is the process of reducing substances to a state of minute division by triturating them after they have been made into a paste with

FIG. 206.

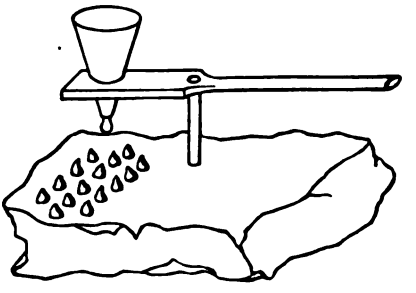


Slab and muller.

water or other liquid. This is effected in a shallow mortar with a flat-surfaced pestle, or upon a ground-glass slab with a flat-surfaced glass muller (see Fig. 206). The motion imparted to the muller, A, closely resembles the figure 8; this is frequently varied with that of elongated circles which intersect each other, the object being to vary the motion so that all particles of the powder may be brought under the action of the muller upon the slab G. Certain substances, like red mercuric oxide and zinc oxide, if made into a paste with alcohol or water, are more readily reduced to fine powder in this way than by the action of the mortar and pestle. The process is termed *porphyrization* when performed with a porphyry slab and muller.

Elutriation is the process of obtaining a substance in fine powder by suspending an insoluble powder in water, allowing the heavier particles to fall to the bottom of the vessel, and decanting the liquid containing the lighter particles into another vessel, and there collecting them. It is *water-sifting* practically, wherein the superior gravity of the larger particles is used as a means of separating them from the smaller. Prepared chalk is a familiar illustration of an elutriated powder.

FIG. 207.



Trochiscator.

Trochiscation is the process of making the pasty mass or magma obtained by elutriation into dry, conical masses. This is usually accomplished by the use of the little apparatus shown in Fig. 207. This consists of a tinned-iron cone, supported in a circular wooden frame which has one short wooden leg and a handle. A slab of chalk or other porous sub-

stance is provided, and after filling the cone with the pasty mass the handle is taken in the right hand and the leg of the frame is tapped gently upon the slab of chalk: the shock causes a conical mass of the substance to fall upon it, whereupon the moisture present soon becomes absorbed, so that the little cone dries quickly. A succession of taps, with a slight lateral movement, deposits the cones in regular rows, and when the slab is full the first cones are found to be dry enough to be transferred, and all will soon be in the same condition. Chalk, bismuth, lake, and other insoluble powders are formed into conical nodules in this way.

Pulverization by Intervention is the process of reducing substances to powder through the use of a foreign substance, from which the powder is subsequently freed by some simple method. No general process can be given for this method of pulverization, as the character of the substance must determine the method. The metal gold may be powdered by rubbing gold-leaf in a mortar in contact with potassium sulphate: the latter is subsequently dissolved out with water. Camphor may be pulverized through the addition of a few drops of alcohol, chloroform, or other solvent. The foreign substance in this case is disposed of through evaporation. Metallic tin may be granulated by melting it and agitating it in a box containing powdered chalk: the latter is subsequently dissolved out with diluted acetic acid. Phosphorus may be pulverized by placing it in water contained in a small flask, then heating the water gradually until the phosphorus is melted, and shaking the flask while the phosphorus is cooling: the agitation in the presence of water keeps the particles from cohering.

CHAPTER IX.

SOLUTION.

Solution.—By this term is meant the process whereby a solid or gaseous substance is liquefied or made to disappear when brought in contact with a liquid: the particles of the substance being uniformly diffused through the liquid, no separation takes place upon standing. The liquid used to effect this change is called a *solvent*, and, after its combination with the dissolved substance, a *solution;* if the liquid has exercised its powers as a solvent to its utmost extent, and is incapable of retaining any more of the dissolved substance, it is termed a *saturated solution.* A substance which is not acted on by a solvent is said to be *insoluble.*

Solution of Solids.—This is an operation which is very frequently performed by the pharmacist: in this place only the methods of effecting the solution of solid bodies which can be entirely dissolved in the solvent will be noticed. This excludes the operations of Infusion, Decoction, Percolation, Maceration, etc., which will be considered at length in subsequent chapters. Solution may be of two kinds: 1, Simple; 2, Chemical.

1. **Simple Solution** is where the solid suffers no alteration on being dissolved, except that which depends upon its external form, and where, if the reverse operation of evaporation is applied, the solid substance is recovered unchanged. The making of simple syrup is an example.

2. **Chemical Solution** is where the properties of the dissolved body are changed by the chemical action of the solvent or some of the substances added, and the simple process of evaporation results in the production of a body having different properties, as, for example, in the officinal solution of nitrate of mercury.

Effects of Pulverization and Agitation.—The solution of solids may be facilitated by pulverizing them and stirring the mixture, thus increasing their extent of surface and promoting the frequent contact of the surfaces with fresh portions of the solvent. This is easily illustrated, as already noted under Comminution, by placing half an ounce of lump alum and half an ounce of powdered alum each in a pint of water at the same time: a few vigorous stirs will soon cause the latter to dissolve, whilst the former will require a much longer time.

Effect of Heat.—The application of heat generally favors solubility, for nearly all substances are more soluble in hot liquids than in cold ones. In addition to this, the convection currents in the liquid caused by heat hasten the solution by constantly bringing fresh surfaces into

contact with the liquid. In many cases the ratio of solubility is not the same for equal increments of heat.

Density of Solutions.—The effect of dissolving a solid body, specifically heavier than the solvent, is always to increase the density of the liquid in which the solid is dissolved. The specific gravity of water is 1.000: if five per cent. of sugar is dissolved in it, the specific gravity is 1.021; if ten per cent., 1.070; if twenty per cent., 1.088, etc. This fact is capable of optical proof; for if a piece of sugar is suspended near the top of some water in a beaker, the downward currents of the solution can readily be noticed if viewed by transmitted light.

Solubility of Substances in Saturated Solutions.—Whilst a saturated solution is one which is incapable of dissolving any more of the substance which was dissolved in the liquid, it must not be assumed that the saturated solution will not dissolve *other* solids. For example, if granulated potassium nitrate be mixed with two per cent. of copper sulphate, and then placed in a funnel having a plug of cotton in the throat, it will be found that the copper sulphate can be very easily removed by pouring on the potassium nitrate mixture a *saturated solution* of potassium nitrate. The potassium nitrate cannot suffer loss, because the liquid passing through is a saturated solution of the same substance; but copper sulphate is soluble in a saturated solution of potassium nitrate, and it is thus washed out.

Reduction in Temperature caused by Rapid Solution.—When solids dissolve rapidly in liquids without chemical action, a reduction in temperature always takes place, and cold is produced, in accordance with the well-known law governing the conversion of solids into liquids, whereby sensible heat is converted into latent heat. The so-called freezing mixtures are produced in this way: thus, if five parts of potassium sulphocyanide are quickly mixed with four parts of cold water, the temperature of the solution falls to —20° C. (—4° F.); thirty-two parts of sodium chloride, if mixed with one hundred parts of snow, will produce a brine having a freezing-point of —23° C. (—9.4° F.). Equal parts of crystallized calcium chloride and snow, when well mixed, will have a temperature as low as —45° C. (—49° F.).

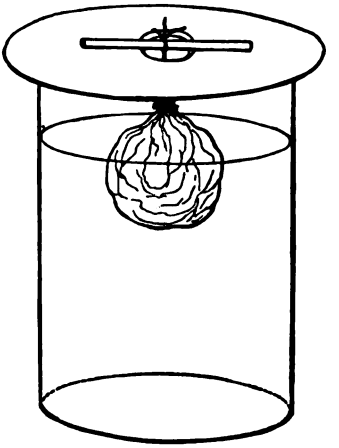
Elevation of Temperature produced by Solution accompanied by Chemical Action.—If chemical action takes place whilst solution is progressing, the opposite effect, or elevation of temperature, is frequently produced, as in dissolving anhydrous salts. The same fact is noticed when the solution of an alkaline oxide made by calcination is effected by treating it with an acid, as when calcined magnesia is dissolved in a solution of citric acid.

Modes of Effecting Solutions of Solids.—The method usually employed by the pharmacist is by the use of the solution mortar and pestle (see page 159). The ordinary practice is to crush the substance into fragments in the mortar with the pestle, and then pour upon it the solvent, meanwhile stirring with the pestle until solution is effected. If definite quantities are used, and the whole of the solvent is required to dissolve the given weight of the salt, a portion only of the solvent should be added at first, and when this is saturated the solution is poured off, and a fresh portion of solvent added: this operation is

repeated until the solid is entirely dissolved; the solutions are then mixed. Other methods of effecting solution are to shake the solid with the liquid in a bottle or flask, or to apply heat to the substances in a suitable vessel.

Circulatory Solution.—A very excellent mode of dissolving substances, particularly where the solid is not very soluble or the relative proportion of liquid is small, is to suspend the solid near the top of the liquid upon a porous diaphragm or a suitable sieve, or tied up in a gauze bag if its nature will admit of this treatment. The parts immediately in contact with the solvent are dissolved, and the solution descends, its place being supplied by fresh portions of the solvent: a circulation is thus created and solution facilitated (see Fig. 208).

FIG. 208.



Circulatory solution.

Solvents used in Pharmacy.—*Water.*—The most useful of all solvents is water. It has a more extensive range than any other liquid, and the aqueous solutions are among the most important preparations of pharmacy. They are especially treated of in chapters, under the head of Liquores, Aquæ, Syrupi, etc.

Alcohol as a solvent is next in importance to water. It has an important advantage over water in the fact that preparations made with it keep almost indefinitely, whilst most aqueous solutions of organic substances soon decompose or become worthless. Resins, volatile oils, alkaloids, glucosides, salts, etc., are dissolved by alcohol, whilst many inert principles, like gum, albumen, and starch, are insoluble in it, so that it has also great usefulness in its negative character.

Glycerin is an excellent solvent, although its range is not so extensive as either of the preceding: it has in its concentrated state antiseptic qualities of a high order, but has not the valuable negative qualities of alcohol. It dissolves the fixed alkalies, some of the alkaline earths, a large number of neutral salts, and vegetable acids, pepsin, tannin, etc., but it also dissolves gum, albumen, starch, etc., and thus its solutions are generally loaded with inert constituents. (See Glycerites.)

Ether is a good solvent for special purposes. Oils, fats, resins, and some of the alkaloids and neutral principles are dissolved by it.

Benzin is very similar in its solvent properties to ether.

Chloroform resembles ether and benzin as a solvent. It has an advantage over both, however, in not being inflammable, although its costliness prevents any extended application.

Bisulphide of Carbon is an excellent solvent for rubber, phosphorus, etc. Its range is limited, however, and its odor and inflammability detract from its usefulness.

Acids, either strong or diluted, are used as solvents; as in vinegars.

Oils are also used in this way in liniments, etc.

Table of the Solubility of Officinal Chemicals in Water and in Alcohol.

Abbreviations: s. = soluble; ins. = insoluble; sp. = sparingly; v. = very; alm. = almost; dec. = decomposed.

Chemicals.	One part is soluble	In Water.		In Alcohol.	
		At 15° C. (59° F.).	Boiling	At 15° C. (59° F.).	Boiling.
		Parts.	Parts.	Parts.	Parts.
Acidum Arseniosum		30–80	15	sp.	sp.
" Benzoicum		500	15	3	1
" Boricum		25	3	15	5
" Carbolicum		20	—	v. s.	v. s.
" Chromicum		v. s.	v. s.	dec.	dec.
" Citricum		0.75	0.5	1	0.5
" Gallicum		100	3	4.5	1
" Salicylicum		450	14	2.5	v. s.
" Tannicum		6	v. s.	0.6	v. s.
" Tartaricum		0.7	0.5	2.5	0.2
Alumen		10.5	0.3	ins.	ins.
" Exsiccatum		20	0.7	ins.	ins.
Aluminii Hydras		ins.	ins.	ins.	ins.
" Sulphas		1.2	v. s.	alm. ins.	alm. ins.
Ammonii Benzoas		5	1.2	28	7.6
" Bromidum		1.5	0.7	150	15
" Carbonas		4	dec.	dec.	dec.
" Chloridum		3	1.37	alm. ins.	alm. ins.
" Iodidum		1	0.5	9	3.7
" Nitras		0.5	v. s.	20	3
" Phosphas		4	0.5	ins.	ins.
" Sulphas		1.3	1	sp.	sp.
" Valerianas		v. s.	v. s.	v. s.	v. s.
Antimonii et Potassii Tartras		17	3	ins.	ins.
" Oxidum		alm. ins.	alm. ins.	ins.	ins.
" Sulphidum		ins.	ins.	ins.	ins.
" Sulphidum Purificatum		ins.	ins.	ins.	ins.
Antimonium Sulphuratum		ins.	ins.	ins.	ins.
Apomorphinæ Hydrochloras		6.8	dec.	50	dec.
Argenti Cyanidum		ins.	ins.	ins.	ins.
" Iodidum		ins.	ins.	ins.	ins.
" Nitras		0.8	0.1	26	5
" " Fusus		0.6	0.5	25	5
" Oxidum		v. sp.	v. sp.	ins.	ins.
Arsenii Iodidum		3.5	dec.	10	dec.
Atropina		600	35	v. s.	v. s.
Atropinæ Sulphas		0.4	v. s.	6.5	v. s.
Bismuthi Citras		ins.	ins.	ins.	ins.
" et Ammonii Citras		v. s.	v. s.	sp.	sp.
" Subcarbonas		ins.	ins.	ins.	ins.
" Subnitras		ins.	ins.	ins.	ins.
Bromum		33	—	dec.	dec.
Caffeina		75	9.5	35	v. s.
Calcii Bromidum		0.7	v. s.	1	v. s.
" Carbonas Præcipitatus		ins.	ins.	ins.	ins.
" Chloridum		1.5	v. s.	8	1.5
" Hypophosphis		6.8	6	ins.	ins.
" Phosphas Præcipitatus		ins.	ins.	ins.	ins.
Calx		750	1300	ins.	ins.
Camphora Monobromata		alm. ins.	alm. ins.	v. s.	v. s.
Cerii Oxalas		ins.	ins.	ins.	ins.

Solubility of Officinal Chemicals in Water and in Alcohol.—(*Continued.*)

Chemicals. One part is soluble	In Water.		In Alcohol.	
	At 15° C. (59° F.).	Boiling.	At 15° C. (59° F.).	Boiling.
	Parts.	*Parts.*	*Parts.*	*Parts.*
Chloral	v. s.	v. s.	v. s.	v. s.
Chrysarobinum	alm. ins.	alm. ins.	sp.	sp.
Cinchonidinæ Sulphas	100	4	71	12
Cinchonina	alm. ins.	alm. ins.	110	28
Cinchoninæ Sulphas	70	14	6	1.5
Codeina	80	17	v. s.	v. s.
Creta Præparata	ins.	ins.	ins.	ins.
Cupri Acetas	15	5	135	14
" Sulphas	2.6	0.5	ins.	ins.
Elaterinum	ins.	ins.	125	2
Ferri Chloridum	v. s.	v. s.	v. s.	v. s.
" Citras	s.	v. s.	ins.	ins.
" et Ammonii Citras	v. s.	v. s.	ins.	ins.
" " " Sulphas	3	0.8	ins.	ins.
" " " Tartras	v. s.	v. s.	ins.	ins.
" " Potassii Tartras	v. s.	v. s.	ins.	ins.
" " Quininæ Citras	s.	v. s.	ins.	ins.
" " Strychninæ Citras	v. s.	v. s.	ins.	ins.
" Hypophosphis	sp.	sp.	ins.	ins.
" Lactas	40	12	alm. ins.	alm. ins.
" Oxalas	sp.	sp.	ins.	ins.
" Oxidum Hydratum	ins.	ins.	ins.	ins.
" Phosphas	v. s.	v. s.	ins.	ins.
" Pyrophosphas	v. s.	v. s.	ins.	ins.
" Sulphas	1.8	0.3	ins.	ins.
" " Præcipitatus	1.8	0.3	ins.	ins.
" Valerianas	ins.	dec.	v. s.	v. s.
Hydrargyri Chloridum Corrosivum	16	2	3	1.2
" " Mite	ins.	ins.	ins.	ins.
" Cyanidum	12.8	3	15	6
" Iodidum Rubrum	alm. ins.	alm. ins.	130	15
" Iodidum Viride	alm. ins.	alm. ins.	ins.	ins.
" Oxidum Flavum	ins.	ins.	ins.	ins.
" " Rubrum	ins.	ins.	ins.	ins.
" Subsulphas Flavus	ins.	ins.	ins.	ins.
" Sulphidum Rubrum	ins.	ins.	ins.	ins.
Hydrargyrum Ammoniatum	ins.	ins.	ins.	ins.
Hyoscyaminæ Sulphas	v. s.	v. s.	v. s.	v. s.
Iodoformum	ins.	ins.	80	12
Iodum	sp.	—	11	—
Lithii Benzoas	4	2.5	12	10
" Bromidum	v. s.	v. s.	v. s.	v. s.
" Carbonas	130	130	ins.	ins.
" Citras	5.5	2.5	sp.	sp.
" Salicylas	v. s.	v. s.	v. s.	v. s.
Magnesia	alm. ins.	alm. ins.	ins.	ins.
" Ponderosa	alm. ins.	alm. ins.	ins.	ins.
Magnesii Carbonas	alm. ins.	alm. ins.	ins.	ins.
" Sulphas	0.8	0.15	ins.	ins.
" Sulphis	20	19	ins.	ins.
Mangani Oxidum Nigrum	ins.	ins.	ins.	ins.
" Sulphas	0.7	0.8	ins.	ins.
Morphina	v. sp.	500	100	36
Morphinæ Acetas	12	1.5	68	14
" Hydrochloras	24	0.5	63	31
" Sulphas	24	0.75	702	144
Phosphorus	ins.	ins.	v. sp.	v. sp.
Physostigminæ Salicylas	130	30	12	v. s.

Solubility of Officinal Chemicals in Water and in Alcohol.—(*Continued.*)

Chemicals. One part is soluble	In Water.		In Alcohol.	
	At 15° C. (59° F.).	Boiling.	At 15° C. (59° F.).	Boiling.
	Parts.	*Parts.*	*Parts.*	*Parts.*
Picrotoxinum	150	25	10	3
Pilocarpinæ Hydrochloras	v. s.	v. s.	v. s.	v. s.
Piperina	alm. ins.	alm. ins.	30	1
Plumbi Acetas	1.8	0.5	8	1
" Carbonas	ins.	ins.	ins.	ins.
" Iodidum	2000	200	v. sp.	v. sp.
" Nitras	2	0.8	alm. ins.	alm. ins.
" Oxidum	ins.	ins.	ins.	ins.
Potassa	0.5	v. s.	2	v. s.
Potassii Acetas	0.4	v. s.	2.5	v. s.
" Bicarbonas	3.2	dec.	alm. ins.	alm. ins.
" Bichromas	10	1.5	ins.	ins.
" Bitartras	210	15	v. sp.	v. sp.
" Bromidum	1.6	1	200	16
" Carbonas	1	0.7	ins.	ins.
" Chloras	16.5	2	v. sp.	v. sp.
" Citras	0.6	v. s.	v. sp.	v. sp.
" Cyanidum	2	1	sp.	sp.
" et Sodii Tartras	2.5	v. s.	alm. ins.	alm. ins.
" Ferrocyanidum	4	2	ins.	ins.
" Hypophosphis	0.6	0.3	7.3	3.6
" Iodidum	0.8	0.5	18	6
" Nitras	4	0.4	alm. ins.	alm. ins.
" Permanganas	20	.3	dec.	dec.
" Sulphas	9	4	ins.	ins.
" Sulphis	4	5	sp.	sp.
" Tartras	0.7	0.5	alm. ins.	alm. ins.
Quinidinæ Sulphas	100	7	8	v. s.
Quinina	1600	700	6	2
Quininæ Bisulphas	10	v. s.	82	v. s.
" Hydrobromas	16	1	3	1 or less.
" Hydrochloras	34	1	3	v. s.
" Sulphas	740	30	65	3
" Valerianas	100	40	5	1
Saccharum	0.5	0.2	175	28
" Lactis	7	1	ins.	ins.
Salicinum	28	0.7	30	2
Santoninum	alm. ins.	250	40	3
Soda	1.7	0.8	v. s.	v. s.
Sodii Acetas	3	1	30	2
" Arsenias	4	v. s.	v. sp.	60
" Benzoas	1.8	1.3	45	20
" Bicarbonas	12	dec.	ins.	ins.
" " Venalis	12	dec.	ins.	ins.
" Bisulphis	4	2	72	49
" Boras	16	0.5	ins.	ins.
" Bromidum	1.2	0.5	13	11
" Carbonas	1.6	0.25	ins.	ins.
" Chloras	1.1	0.5	40	43
" Chloridum	2.8	2.5	alm. ins.	alm. ins.
" Hypophosphis	1	0.12	30	1
" Hyposulphis	1.5	0.5	ins.	ins.
" Iodidum	0.6	0.3	1.8	1.4
" Nitras	1.3	0.6	sp.	40
" Phosphas	6	2	ins.	ins.
" Pyrophosphas	12	1.1	ins.	ins.
" Salicylas	1.5	v. s.	6	v. s.
" Santoninas	3	0.5	12	3.4

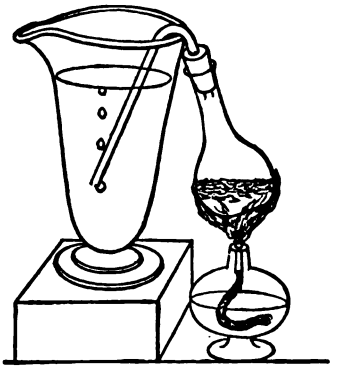
Solubility of Officinal Chemicals in Water and in Alcohol.—(*Continued.*)

Chemicals. One part is soluble	In Water.		In Alcohol.	
	At 15° C. (59° F.).	Boiling.	At 15° C. (59° F.).	Boiling.
	Parts.	*Parts.*	*Parts.*	*Parts.*
Sodii Sulphas	2.8	0.4	ins.	ins.
" Sulphis	4	0.9	sp.	sp.
" Sulphocarbolas	5	0.7	132	10
Strychnina	6700	2500	110	12
Strychninæ Sulphas	10	2	60	2
Sulphur Lotum	ins.	ins.	ins.	ins.
" Præcipitatum	ins.	ins.	ins.	ins.
" Sublimatum	ins.	ins.	ins.	ins.
Thymol	1200	900	1	v. s.
Veratrina	v. sp.	v. sp.	3	v. s.
Zinci Acetas	3	1.5	30	3
" Bromidum	v. s.	v. s.	v. s.	v. s.
" Carbonas Præcipitatus	ins.	ins.	ins.	ins.
" Chloridum	v. s.	v. s.	v. s.	v. s.
" Iodidum	v. s.	v. s.	v. s.	v. s.
" Oxidum	ins.	ins.	ins.	ins.
" Phosphidum	ins.	ins.	ins.	ins.
" Sulphas	0.6	0.3	ins.	ins.
" Valerianas	100	—	40	—

SOLUTION OF GASES IN LIQUIDS.

The methods employed to effect the solution of gases in liquids differ essentially from ordinary processes of solution, and depend upon the solubility of the gas in the liquid, relative specific gravity, and the strength of the solution desired. It is usually sufficient to conduct the gas into the liquid by a suitable tube, reaching nearly to the bottom, when more or less of the gas is absorbed by the liquid. Fig. 209 shows a simple method where the gas is readily soluble in the liquid, as in making chlorine water. For a continuous operation, as in making hydrochloric, nitric, and hydrobromic acids, and similar liquids, the well-known Woulffe's, or three-necked, bottles are employed advantageously, the gas which escapes solution in one bottle passing over into the next. The washing-bottle shown in Fig. 210 is easily made, and well adapted for purifying the gas after it is generated. B is an ordinary wide-mouthed bottle, closed with a perforated rubber cork, C; a wide tube, DE, passes nearly to the bottom, and a narrow tube, A, is joined by a short piece of rubber tubing, J, to the tube leading from the generating flask, and at the other extremity is curved upward so as properly to deliver the gas into the water placed in the bottle to wash it: it escapes by the bent tube, T, which is continued until it dips into the liquid in which the gas is to be dissolved. The

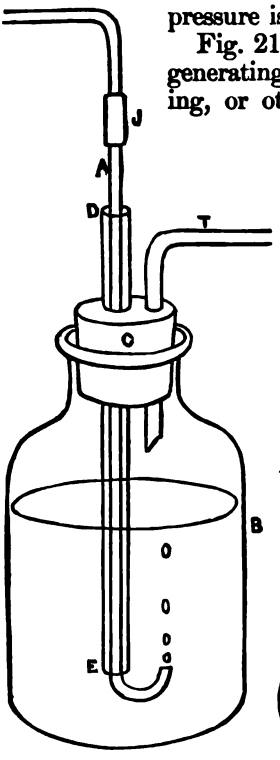
FIG. 209.



Method of absorbing gas.

space between the tube A and the wide tube D E acts as a safety-valve: if the pressure accumulates through the too rapid generation of the gas, or if a stoppage occurs in the delivery-tube, the liquid in the bottle is first blown out through this space, and the pressure is thus relieved.

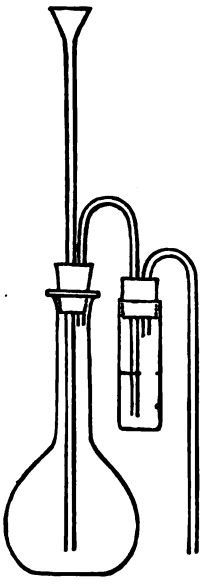
FIG. 210.



Wash-bottle.

Fig. 211 shows a very convenient little apparatus for generating and washing small quantities of gases, for testing, or other purposes: the wash-bottle is made from a homœopathic vial, rubber corks being used, and the bent tubes by bending ordinary glass tubing over a flame as described on page 121. The funnel-tube permits the addition of fresh liquid to hasten or continue the action as the operation progresses. It is usual to add merely sufficient water to cover the orifice of the delivery-tube in the wash-liquid at the beginning of an operation, as the aqueous vapor carried over by the gas condenses in the wash-bottle, which soon increases in quantity, and may accumulate in a long operation to an extent which will necessitate a partial discharge of its contents or the entire cessation of the process. As the apparatus suitable for each operation must be especially selected, general observations on the solution of gases will not be so useful in this chapter as a detailed process in connection with each preparation where it is described in the subsequent pages. One general rule should be noted, however,—*i.e.*, that gases are generally more rapidly and thoroughly absorbed by cold liquids than by hot ones: hence the receiving bottle should be kept surrounded by ice or otherwise refrigerated.

FIG. 211.



Gas-generator.

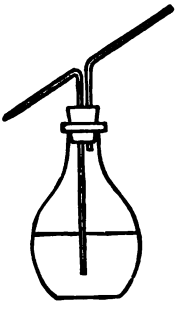
CHAPTER X.

SEPARATION OF FLUIDS FROM SOLIDS.

THE operations involved under this head are among those which are most frequently used in pharmacy,—*i.e.*, Lotion, Decantation, Colation, Filtration, Clarification, Expression, Percolation, etc.,—and the principles which govern the successful performance of these practical processes should be mastered early in the career of the student. They are almost exclusively mechanical processes.

Lotion, or Displacement Washing, is the process of separating soluble matter from a solid by pouring a liquid upon it which will dissolve and wash out the soluble portion. The separation of the fluid from the solid is generally effected by placing an obstruction in a funnel or cylindrical vessel, such as a plug of cotton or tow, notched cork, filter-paper, etc., and then, having introduced the solid into the funnel and arranged a suitable vessel beneath, the liquid is poured upon it. (See Percolation.) Precipitates are frequently purified from contaminating soluble matter in this way. A very convenient method of applying the liquid is by the use of the spritz bottle (see Fig. 212). This is usually made from a flask, but a round-shouldered pint bottle of the diameter most easily grasped by the hand is preferable. Two glass tubes, one bent at an acute angle and the other at an obtuse angle, are used; one end of the former is drawn out to a capillary orifice, and the other extends nearly to the bottom of the bottle. The obtuse-angled tube merely enters the bottle below the cork; the upper portion of this tube should be held in the gas-flame, so as to fuse the edges of the glass and thus prevent cutting the lips when it is used. By filling the bottle with liquid, and blowing with the mouth through the tube, a stream of liquid is ejected from the capillary orifice which can be directed to any portion of a solid substance that is to be washed. It is often desirable, in order to save time, to use the liquid hot. One of the wicker-covered bottles in which Farina cologne is imported answers a good purpose here to prevent burning the fingers, and if care is used to pour in a small quantity of hot liquid first and agitate it before adding the rest, so that the glass may be *gradually* warmed, there is no danger of fracturing the bottle.

FIG. 212.

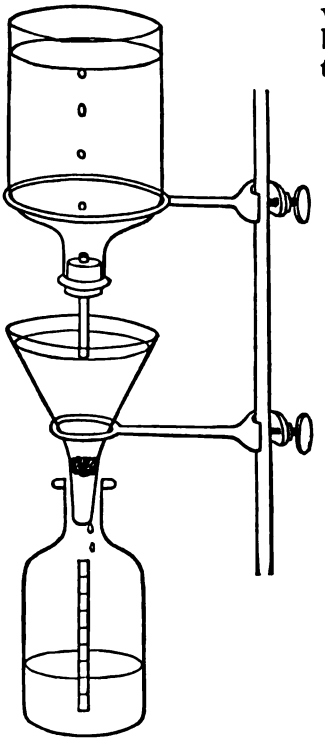


Spritz bottle.

Continuous Washing.—The use of the spritz bottle for small operations is convenient. A simple method of automatically supplying the wash-liquid in larger quantities is shown in Fig. 213. This requires

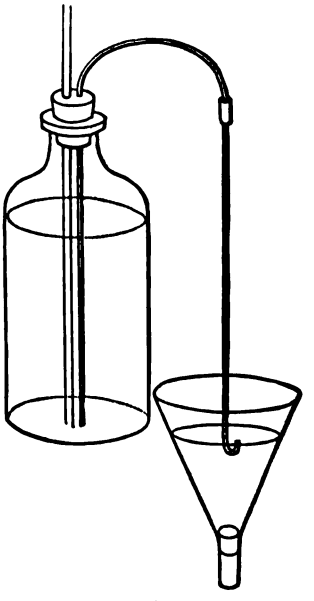
no attention from the operator except at the beginning of the operation. The bottle is furnished with a perforated cork and a short glass tube. All that is necessary is to fill the bottle and adjust it over the funnel so that the end of the tube shall be at the height desired for the liquid: on tilting the bottle slightly (if the tube selected is not too narrow in diameter) the liquid will run out into the funnel until it rises to the orifice of the tube, when the flow will cease. As the liquid gradually passes through the solid substance in the funnel, the level falls, and bubbles of air pass through the tube into the bottle, the liquid once more flows, and the operation continues until the bottle is empty. Many elaborate methods of continuous washing have been suggested, and many have been practically tried by the author, but if care is taken in the simple apparatus just described to have the tube of proper diameter, at least so wide that the force of capillary attraction shall not be strong enough to prevent the ingress of air, it is the most satisfactory of all. Bottles having narrow mouths may often be used in the same way, and the cork and tube be dispensed with. A little practice will enable the operator to make a bottle in which the parts are adjusted to a nicety. On the large scale, Prof.

FIG. 213.



Continuous washing.

FIG. 214.



Continuous-washing apparatus.

B. S. Proctor's suggestion of two carboys may be used,—one above and inverted, containing the liquid, supported by a box having a circular hole cut in its side, and the other inside the box, containing the funnel and filter.

A modification of Gay-Lussac's apparatus is one of the most successful and practical for continuous washing (see Fig. 214). The bottle containing the wash-liquid is furnished with a doubly-perforated cork and two glass tubes: one is bent as shown in the cut, and its lower extremity curved upward. By blowing a current of air through the other tube the syphon-tube is filled, and the extremity may then be adjusted to such a height in the funnel as is desired. When the level of the liquid in the funnel falls below the orifice of the tube, bubbles of air will enter the bottle through the air-tube, and the liquid will run out until it rises in the funnel to the level of the ends of the tubes, when it will cease. It will be found a practical convenience to cut the syphon-tube just below the bend, so that a piece of rubber tubing may be used to form a flexible joint.

Decantation.—The process of separating a fluid from a solid by decantation is very simple, and consists usually in allowing the solid to deposit at the bottom of the vessel, and then carefully pouring off the liquid by inclining the vessel. The theory of washing by decantation shows its effectiveness, and this may be illustrated by the following example. If 360 grains of mercuric chloride dissolved in 50 fluidounces of water are mixed with 220 grains of potassium iodide dissolved in 50 fluidounces of water, double decomposition takes place, an insoluble precipitate of mercuric iodide subsides, and 100 grains of potassium chloride remain dissolved in the 100 fluidounces of water. As it is desirable to free the mercuric iodide from the contamination of potassium chloride, the supernatant liquid is poured off; if 90 fluidounces are decanted, 90 grains, or $\frac{9}{10}$ of the whole quantity of potassium chloride, are thus disposed of, and 10 grains are left. If the vessel is filled with water to 100 fluidounces, and 90 fluidounces are again poured off, 9 grains are again removed, and but 1 grain is left; this by a third washing and decantation in a similar manner would be reduced to $\frac{1}{10}$ of a grain, and thus the purification is speedily effected. Some skill is required to decant liquids neatly from vessels of various shapes, particularly if they are not furnished with lips, or if filled nearly to the brim. The *guiding-rod* may be used in many cases with effect: indeed, it is a good practice to form the habit of using a stirrer or rod as a guide in decanting, as shown in Fig. 215, for it has a tendency to steady the hand of the operator. The practice recom-

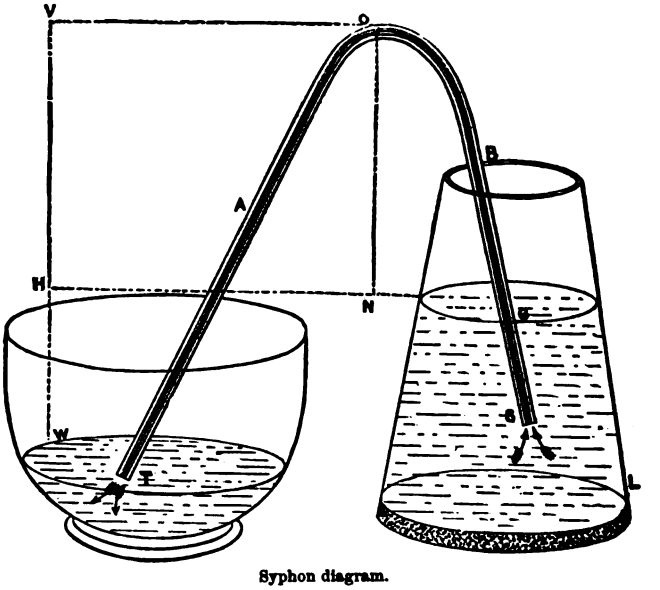
FIG. 215.

Use of the guiding-rod.

mended by some writers of greasing the rim of the vessel to facilitate decantation is a clumsy and usually unsuccessful expedient.

The Syphon (or **Siphon**).—It often happens in washing solid substances that decantation by pouring off the liquid cannot be successfully performed, either because the vessel is too full, or because, owing to the light character of the precipitate, the inclination of the vessel is sufficient to cause a disturbance in the powder, and an admixture of the liquid and solid. In such cases, and in many others, the useful instrument known as the syphon may be resorted to. This usually consists of a glass tube bent at a rather acute angle, and having one of the limbs longer than the other. It is used by filling the syphon with liquid, and then inserting the short limb into the liquid that is to be drawn off, when a flow of liquid from the long limb is established, which need not cease until as much of the liquid is abstracted as is desired. After filling the syphon the liquid may be prevented from running out (if a tube of small diameter is used) by stopping up the end of the long limb with the forefinger of the right hand, or, if the liquid to be drawn off is not caustic or unpleasant to the taste, the short limb of the syphon may be placed in the vessel at the proper height, and suction applied by the mouth at the long end until the current is established. The principle of the action of the syphon is shown in Fig. 216. The combined lengths

FIG. 216.



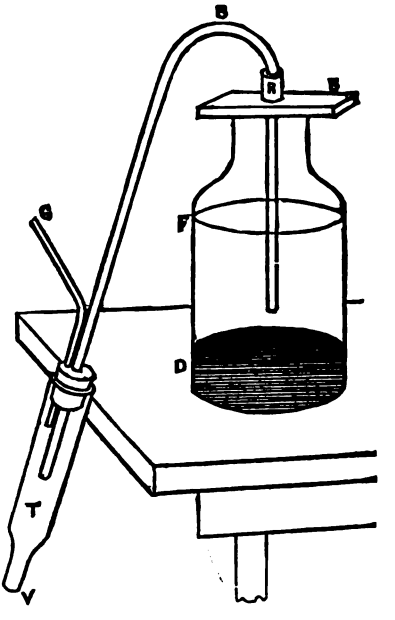
Syphon diagram.

of the limbs of the syphon are not equal to the length of the glass tube, T O S, but the real syphon is only the tube acting between the levels of the liquid in the vessels. In all operations with the syphon there must be a difference in the levels of the liquid. In Fig. 216, O S represents the liquid in the short limb, and O T the liquid in the long

limb. It is obvious that, if an equal-limbed, narrow-tubed syphon is filled with liquid, held level, and left undisturbed, there can be no movement in the liquid; equilibrium is established, because the tubes are equal in length and in diameter, and the pressure of the atmosphere is the same upon all parts of the liquid. But the descending column of liquid in the long limb exceeds in weight that in the short limb, and it follows on account of the excess of weight of liquid in this limb that if it is once set flowing through the longer limb it will continue until the levels of the liquid in the two vessels are the same. It will be observed that the custom of having one limb longer than the other is not a necessity, for if there is sufficient difference between the levels of the liquid the syphon will operate with the position of the limbs reversed; but it is a convenience in a syphon of unequal limbs always to immerse the short limb, as there is then a certainty that the other limb contains the longest column of liquid. The syphon, obviously, cannot be operated in a vacuum, nor if the length of the upward column of water exceeds thirty-three feet.

Syphons for Special Purposes.—In the larger laboratory operations the most convenient syphon is made from a six-, eight-, or ten-foot length of rubber hose. This syphon, on account of its flexibility, can be used in many operations where glass or metal would be inconvenient or inadmissible, whilst its durability and simplicity of operation make it a necessity: indeed, the utility of glass syphons is greatly increased by breaking the long limb just below the bend and joining it to the other by a piece of rubber tube.

FIG. 217.



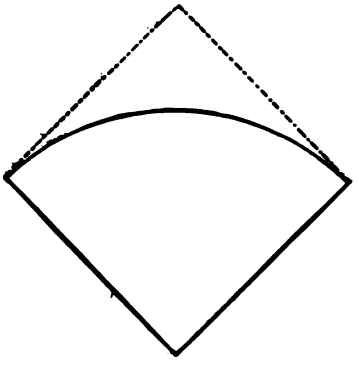
Syphon.

The method, already referred to, of starting a syphon by applying suction with the mouth at the long end, or filling the syphon with liquid, is not always practicable, and various other expedients are in use. The *syphon with a bulbed lateral tube* is useful where caustic liquids are to be decanted. The finger is placed over the end of the long limb, and suction applied at the small tube until the downward current is started. Negretti's syphon has a glass syringe attachment upon the lower part of the long limb to accomplish the same purpose. Fig. 217 represents a modification of Mohr's syphon, the bottom having been cut from a Farina cologne-bottle, T, by starting a cut with a three-cornered file near the bottom and extending it around the surface with a red-hot poker. The edges are now filed so that they are no longer sharp, and a cork is fitted and twice perforated

to admit the longer limb of the syphon, and a suction-tube, G. It is started like the syphon with a lateral tube, the moistened forefinger closing the lower aperture, V, whilst suction is being used at G until the liquid has been started. A simple glass tube, with a short piece of rubber tube attached, is in practical hands an efficient substitute for elaborate contrivances to start the flow in a syphon; even if the liquid is caustic or disagreeable, there is no risk in careful hands if the rubber tube is held between the thumb and finger so that it can be instantly pinched tightly to prevent the upward flow of the liquid into the mouth.

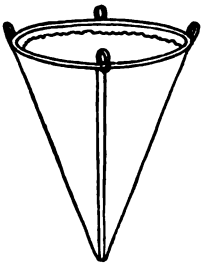
Colation, or Straining (*colare*, to strain), is the process of separating a solid from a fluid by pouring the mixture upon a cloth or porous substance which will permit the fluid to pass through, but will retain the solid. This operation is frequently resorted to for separating sediment or mechanical impurities of various kinds from liquids. Gauze, fine muslin, cotton flannel, woollen felt, and other fabrics are used. Strainers are employed where the solid particles to be removed are not in very fine powder, or where complete separation is not especially desired.

FIG. 218.



Pattern for strainer.

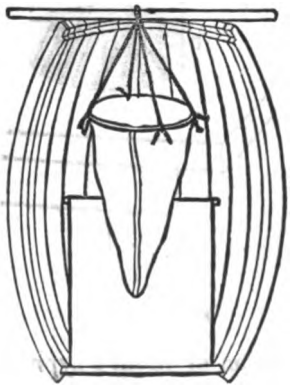
FIG. 219.



Strainer.

Felt Strainers are usually in the shape of felted, seamless, conical bags; the material is of wool and quite thick: they form excellent strainers for melted fats, petrolatum, wax, oils, syrups, elixirs, etc., where a large quantity of substance is to be strained. Their expensiveness is, however, an objection to their use, and the difficulty of cleaning them, owing to the tenacity with which they retain odors, unfits them for general use by the apothecary, but for special purposes in manufacturing pharmacy they are very useful.

FIG. 220.



Use of strainer.

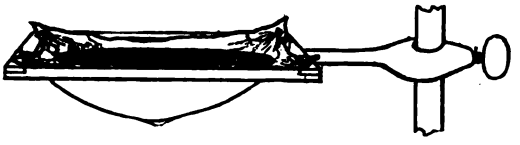
Woollen Strainers made of twilled woollen cloth, flannel blanket material, etc., are more economical, because they can be cut to any size desired, and the material costs less, whilst if the seams are closely sewed or overseamed they will last a long time. The form known as Hippocrates's sleeve (see Fig. 219) is that generally used. Fig. 218 shows the shape and dimensions before being sewed. A wooden hoop or brass ring is required to keep the opening extended. This should

be arranged so that it can be removed when the bag is to be washed. The most convenient support is a stick passed through the cords which are attached to the strainer, the whole suspended in a barrel arranged as shown in Fig. 220. The object of suspending it in the barrel is to avoid currents of air, which, in the case of many liquids, would cause evaporation from the surface and the formation of a crust, and thus impede the rapidity of colation. A tin or copper can of proper size may be placed in the barrel to collect the strained liquid.

Cotton-Flannel or Canton-Flannel Strainers are cheaper than those of woollen, and if bleached they have the great advantage that they can be used for alkaline solutions. The unbleached cotton flannel is probably stronger, but the coloring-matter naturally present, being soluble in alkalies, is apt to discolor the liquid.

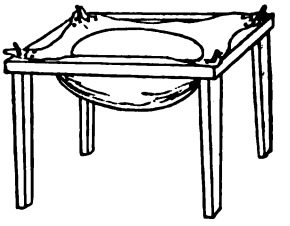
Cotton-Cloth or Muslin Strainers are generally suspended on a wooden frame, as shown in Fig. 221. The frame should be securely joined without glue, and at

FIG. 221.



Cotton-cloth strainer.

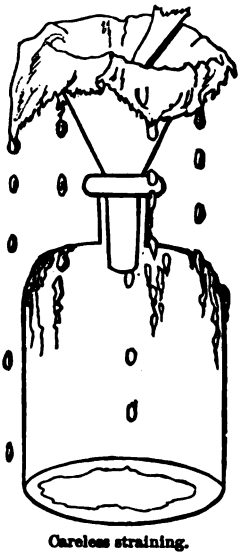
FIG. 222.



Strainer and frame.

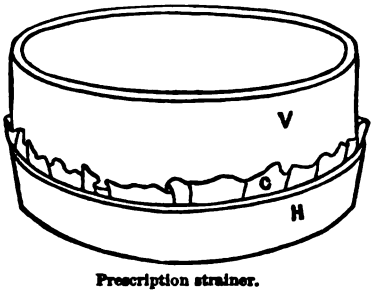
each corner there should be a strong, pointed nail projecting slightly outward. The cotton cloth should always be soaked in boiling water before fastening it to the frame, to dissolve out the substances used by the manufacturer in calendering the goods. Fig. 222 shows the method of fastening the strainer to the frame. It should be secured at each corner, first upon the permanent nails, and then two tacks upon the side of each nail should be driven

FIG. 224.



Careless straining.

FIG. 223.



Prescription strainer.

two-thirds of their length into the frame; this partial driving of the nail is sufficient to hold the cloth and permit of the easy removal of the

tacks. A strainer hung in this way will hold more liquid and do much better work than one which is tacked all around the frame. This method of straining is particularly useful in collecting precipitates which require washing.

Colation in Smaller Operations.—When solid particles are to be separated from liquids in the operations of the dispensing counter, several methods may be used. One of the most convenient is to insert a plug of absorbent cotton in the neck of a funnel and then pass the liquid through; a funnel with a circle of brass-wire gauze soldered in it two-thirds of the way down is sometimes used, although not recommended, because of the difficulty of cleaning it. A better small strainer is made by using the hard-rubber sieve, V H (see Fig. 223). The muslin gauze, C, is easily replaced, and the sieve may be placed in a funnel. The cotton cloth used by the makers of cheese, called cheese-cloth, is admirably adapted for many kinds of straining. When coarse muslin strainers are used for the first time, they are prepared by soaking them in hot water and placing them in a funnel carefully so as to line the inside. Care should also be taken to see that the strainer is not too large, for if the wet strainer projects over the edge of the funnel, a syphon action may be set up and more of the liquid delivered outside of the bottle than inside. Fig. 224 shows the action of such a strainer.

CHAPTER XI.

FILTRATION.

Filtration is the process of separating liquids from solids with the view of obtaining the liquids in a transparent condition. The intervention of porous substances, called *filters*, to intercept the solid particles, is necessary in performing this process. These are usually made from paper, paper pulp, sand, asbestos, ground glass, charcoal, porous stone, etc. The liquid which has passed through the filter is called the *filtrate*.

Paper Filters are the most useful of all kinds for the pharmacist, and they are employed in all the finer operations requiring filtration. The solid particles are much more completely separated by filtration through good paper filters than through strainers, owing to the pores of the paper being smaller and more numerous. The paper used for this purpose is especially prepared, and is called *filtering-paper:* it is made now upon a large scale, and can be had of excellent quality. Unlike a strainer, it is never used more than once; its cost is so trifling, and it is so easily ruptured when wet, that it is not worth while to attempt to save filters for subsequent use. Filtering-paper is found in commerce in two forms,—in large, nearly square sheets, and in circular sheets. The former is used for large filters, and has some advantages, if the waste pieces can be put to use; but it is usually more convenient for the pharmacist to rely for constant use upon the circular sheets of different sizes: the difference in price between the two is now so trifling that the latter is almost always preferred. Two kinds of square-sheet filtering-paper are commonly found,—German white, a rather thin, but good paper, and heavy French, the latter very thick and porous, having a rough surface; it is the more expensive paper, but is better for special purposes. Of the round filters, the French, Swedish, German, English, and Scotch are among those best known in America. For pharmaceutical purposes the French filters are almost universally used, the "Prat Dumas" brand being the most common, the gray paper being made from a mixture of cotton, flax, wool, etc.; this paper answers sufficiently well for filtering colored liquids, fluid extracts, or tinctures, but, owing to the coloring matter it contains, it should never be used for any solution containing free alkali.

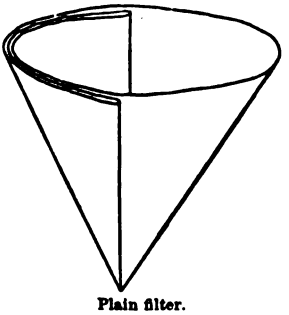
It is safer to form the habit of never using it for liquids that are intended to be colorless when filtered; of course it is entirely unfitted for analytical work. The "Prat Dumas White" is of good quality, and it or some other good quality of white paper should always be on hand

for special purposes, for filtering alkaline or alkaloidal solutions, and for the nicer operations. Very good filtering-paper of English and Scotch manufacture may occasionally be procured; that made in Sweden, however, by Munktell, is preferred for the processes of ignition and analytical work; it yields the smallest amount of ash, and is practically free from soluble salts and impurities: at least a small stock should be kept by pharmacists for especially accurate work.

Methods of Folding Filtering-Paper.—Two kinds of paper filters are used, the *plain* and the *plaited*.

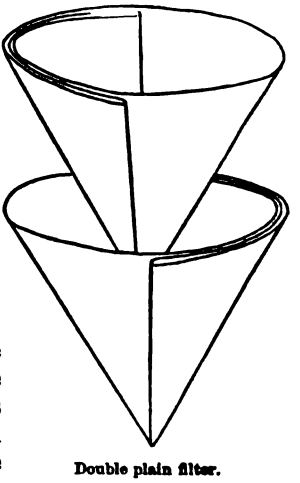
1. *The Plain Filter.*—This filter is used habitually by the analytical chemist, and is preferred by the pharmacist where precipitates are to be collected, and in some other operations (see Fig. 225); it is made by exactly doubling a circular sheet of filtering-paper upon itself, and then folding this directly in the middle, so that, when opened, four equal divisions or sectors appear; the filter is used by separating one of the sectors from the other three, and placing the cone formed, into a funnel; the liquid is then poured upon the filter, and the process of separating the solid from the liquid commences. The advantages of the plain filter are, 1. Simplicity and rapidity in folding, no skill being required to make one. 2. In collecting precipitates, but one-half of the surface of the filter (two sectors) is in contact with the moist precipitate, which is often closely adherent, and therefore but one-half of the surface has to be cleaned. In some cases there may be a disadvantage in the use of the plain filter, owing to the unequal rate of flow,—the tendency of the three folds being to attract the liquid to the side of the funnel upon which they rest, and thus the precipitate may be unequally washed. A stronger and more rapid filter may be made by placing one plain filter inside of another, so that the three sides of the upper one shall be in contact with one side of the lower one, and *vice versa* (see Fig. 226). If the sides of the funnel have an angle of 60°, the plain filter made as described will fit the funnel properly; but it frequently happens that the angles of funnels vary, and if an ordinary plain filter is placed in a funnel not having an angle of 60°, a portion of the filter is left unsupported, and the weight of the liquid is apt to rupture the moist paper. This difficulty may be overcome by making a fresh crease in the outside fold of the plain filter; if this is made to the right of the original crease of the 60° filter, and the inside fold pushed around a corresponding distance,

FIG. 225.



Plain filter.

FIG. 226.



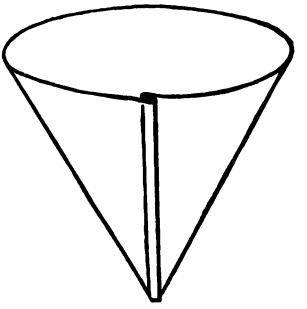
Double plain filter.

a filter having a smaller angle is produced, whilst if the fresh crease is made to the left of the original crease a larger-angled filter may be made. Rother's method of making a plain filter has the advantage of giving two filters from the same sheet that is usually required for one filter. To make it, the circular disk of filtering-paper is cut through in the line of its diameter, and half of the disk is folded into two equal parts; the double edge of the cut sides is turned down and folded over on itself narrowly several times (see Fig. 227), and with the blade

FIG. 227.

Rother's filter (first step).

FIG. 228.

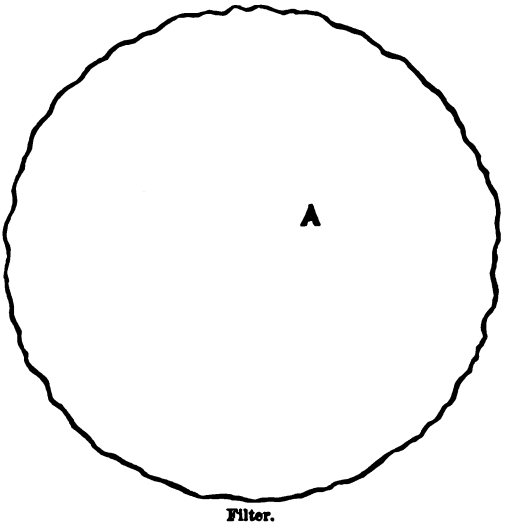


Rother's filter.

or a spatula the fold is compressed so that it will retain its shape (see Fig. 228). This filter may be used in collecting precipitates.

The Plaited Filter may well be called the "pharmacist's filter," for it is the form almost exclusively used in ordinary filtering operations. Figs. 229 to 239 show the progressive steps in the folding of a plaited filter. It is made by folding a circular sheet of filtering-paper twice, as in making a plain filter.[1] The edge B D, Fig. 232, is then laid upon E D, and the crease F D is formed; in like manner C D is laid upon E D, and H D is formed. Then D B is laid upon F D, and I D is formed, and by rolling over the fold in the same direction once more until F D is laid upon E D, the crease K D is made (see Fig. 234). Now in the same way C D is laid upon H D, and H D upon E D, and it will be noticed that the folded semicircle has been creased into eight equal spaces, and that the direction

FIG. 229.



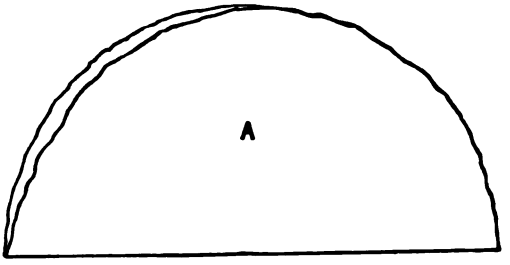
Filter.

[1] It will be observed that in the first folding of French filters, "Prat Dumas," the disks are not perfect circles: this causes one edge to project (see Fig. 230), and facilitates the opening of the filter.

of each crease is the same, so that if the paper is lifted it will appear as shown in Fig. 236.

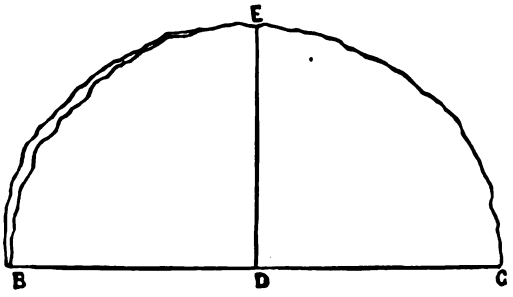
The next step is to fold each one of these spaces *back on itself* (Fig. 237). B D is laid upon F D, and then B D is turned upward and back until it is laid upon I D. This makes the crease Q D, which is the first fold in the opposite direction. Taking both folds between the forefingers and thumbs of both hands, the edges B D and I D are folded upward and back upon F D, and the crease P D is formed; then these three edges, B D, I D, and F D, are taken all together and folded back upon K D, and the crease O D is formed, and so on, each space in turn being folded back in the opposite direction, until the last one is reached. The folded filter is then held at the apex with the left hand upon a table or flat counter, and pressed and smoothed out with the right hand in order to emphasize the folds: it should then be placed in the funnel, whilst still *unopened*, to see whether

FIG. 230.



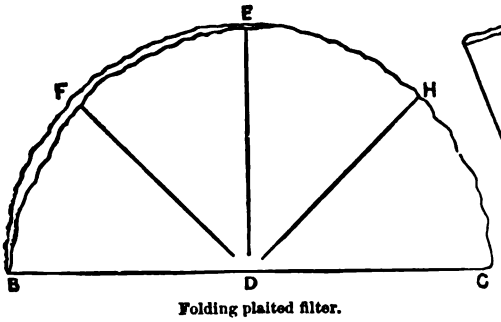
Folding plaited filter.

FIG. 231.



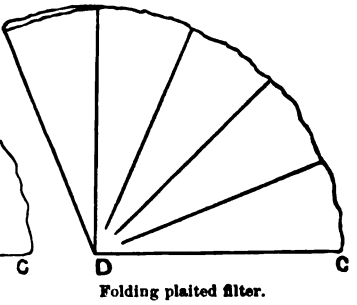
Folding plaited filter.

FIG. 232.



Folding plaited filter.

FIG. 233.



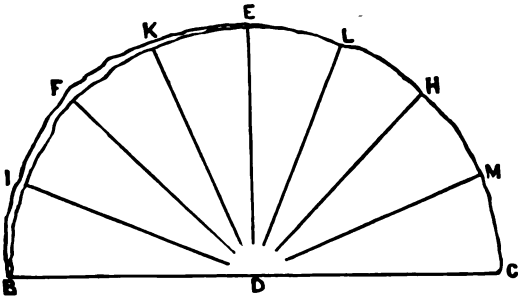
Folding plaited filter.

it needs trimming; if the rough edges of the filter project above the top of the funnel, the filter must be removed, and they must be cut off neatly with a sharp knife or a pair of scissors so that the whole of the filter may be placed inside of the funnel. Having satisfied this re-

quirement, the filter should be carefully opened out (see Fig. 239) and placed in the funnel.

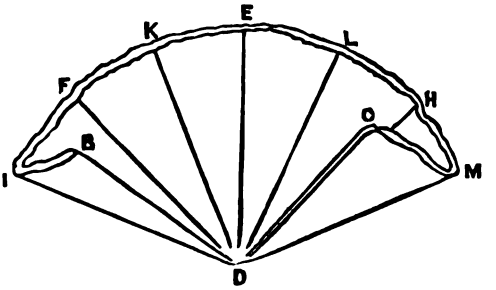
Another method of folding a plaited filter is illustrated in Figs. 240 and 241. A plain filter is folded as in Fig. 225, and the quadrant, consisting of four thicknesses of paper, beginning at the left-hand side, is folded at once into narrow parallel plaits backward and forward. Fig. 240 represents the filter after being once opened, and Fig. 241 shows the inside of the filter: it will be observed that the creases do not converge to a point as in the plaited filter (see Fig. 239), and hence the apex is less likely to be weakened.

FIG. 234.



Folding plaited filter.

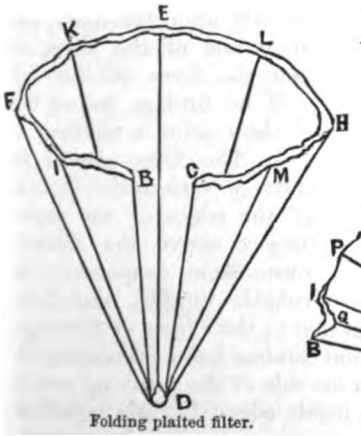
FIG. 235.



Folding plaited filter.

Maxims.—1. In folding a filter, care should be observed not to extend the creases entirely to the apex, but to end them at a distance of about half an inch from it, because the point at which all the creases converge would be thereby so weakened that the weight of the liquid would rupture the filter.

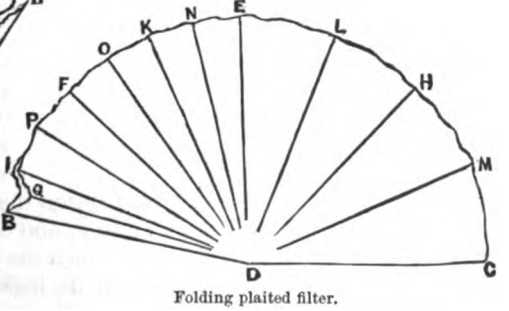
FIG. 236.



Folding plaited filter.

2. The filter should be moistened with water after introducing it into the

FIG. 237.



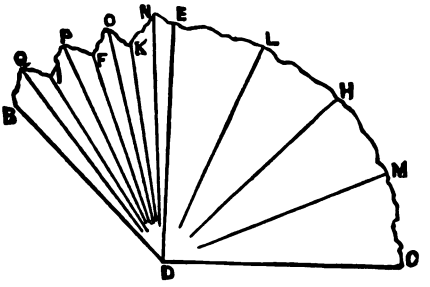
Folding plaited filter.

funnel and before pouring upon it the liquid to be filtered (except, of course, in the case of a liquid immiscible with water): this promotes

rapid filtration, and washes the filter besides. If hot water is available, it is usually to be preferred.

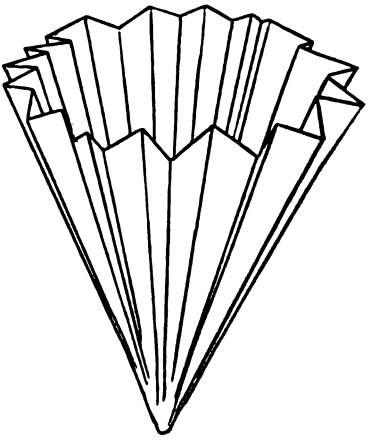
3. If the liquid to be filtered contains free acid or alkali, or if it contains a very fine precipitate, or is very dense or hot, a double filter should be used. In the case of plain filters, they should be arranged as in Fig. 226. If plaited, two sheets of paper should be taken and folded as if they were single. A filter may be also strengthened by placing a small capping filter or plain filter, a piece of well-washed linen or muslin folded like a plain filter, or a plug of absorbent cotton, into the funnel before introducing the filter. The apex is always the weakest, the most exposed, and yet the most important part of the filter.

FIG. 238.



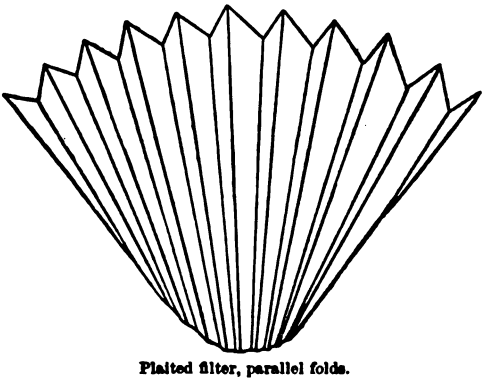
Folding plaited filter.

FIG. 239.



Plaited filter.

FIG. 240.



Plaited filter, parallel folds.

4. In pouring the liquid into the filter, the stream should never be delivered directly upon the apex, but upon one of the sides, so that the force of the fall will be broken before the weakest point is reached.

5. The filter should be entirely within the funnel. If the edges of the paper project above the funnel, waste from evaporation in volatile liquids, also from the increased and unnecessary absorption due to the excess of filtering-paper, ensues, and in addition an untidy and careless habit is encouraged.

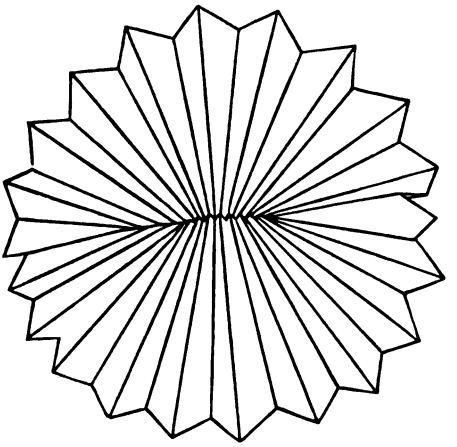
6. The end of the funnel should touch the side of the receiving vessel, so that the filtrate will trickle down its inside edge: by this expedient splashing will be avoided (see Fig. 242).

7. In filtering into a bottle, care should be observed to leave sufficient space between the neck of the funnel and the mouth of the bottle

for the escape of air, otherwise filtration will be retarded or prevented; a piece of twine placed between the two surfaces generally serves a good purpose. *The end of the funnel should project below the lowest part of the neck of the bottle* (see Fig. 243). If the diameter of the end of the funnel is too large to admit of this, or if it is only half inserted, the filtrate will be very apt to fill the intervening space and flow over the outside of the bottle, as shown by the arrows in Fig. 244.

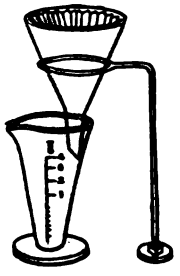
Funnels, sometimes called *tunnels*, are conical-shaped instruments intended to facilitate the pouring of liquids into narrow-mouthed vessels, and, as they have also an important service to perform for the pharmacist in supporting filters, they will be considered in this place. Funnels are made of tinned copper, tinned iron, hard rubber, Berlin-ware, porcelain, queen's-ware, granite- or agate-ware, earthen-ware, or glass. Metallic funnels have an advantage in point of durability over porcelain and glass, but a disadvantage in being acted upon chemically by liquids and in being more difficult to clean. The triangle formed by the sides of a funnel, and the line joining them, should be equilateral (see Fig. 245). The angles being each 60°, a funnel having this shape will accurately support a plain filter made in the usual way. Funnels are frequently fluted, grooved, or ribbed on the inside for the purpose of facilitating the downward flow of the filtrate (see Fig. 246), or wire frames, either fixed or folding, are arranged in a plain funnel with the same object. These aids are of doubtful utility, however, whilst the tendency of the raised ribs is to form a lodgment for foreign substances.

FIG. 241.



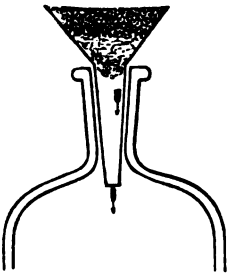
Plaited filter, parallel folds.

FIG. 242.



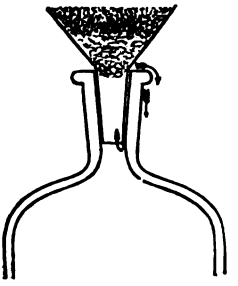
Arrangement of funnel in filtration.

FIG. 243.



Filtering into a bottle (proper method).

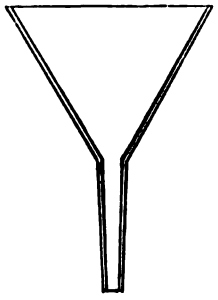
FIG. 244.



Filtering into a bottle (improper method).

A well-made plaited filter in a plain funnel will perform as much work in the same time, and if the habit is once formed of always carefully and skilfully folding a filter, its importance in saving time and labor will be appreciated ever afterwards. One of the ribbed funnels in the market has an improvement in the neck, which, instead of being round, is triangular. This permits the free escape of air from the interior of a bottle, and is much superior to the indistinct groove which is often made on the outside surface of porcelain funnels.

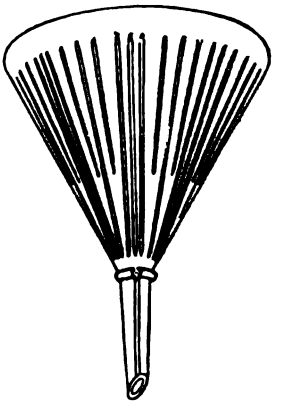
FIG. 245.



Plain funnel.

Plain glass funnels are more generally useful to the pharmacist than any other kind. They are easily cleaned, and dirt upon them may be quickly seen. They are very useful as percolators, and the whole process of filtration or percolation may be observed without trouble. Their only disadvantage is the ease with which they are fractured. The next kind in point of usefulness is the plain tinned-copper funnel. The neck should be made square or triangular, instead of round. Copper funnels are far superior to those made from tinned iron, and the difference in cost is greatly in favor of tinned copper, if true economy is considered. Hard-rubber funnels are light in weight, and are not very easily broken, for they may be often dropped upon the floor without injury. They are not acted upon by chemical substances, and with ordinary care will last a lifetime. They lack one advantage of those made from glass, however, in their absence of transparency. One or two hard-rubber funnels may be usefully employed at the dispensing counter. Porcelain, queen's-ware, or Berlin-ware funnels are, of course, not transparent; and they have the disadvantage, at least in the larger sizes, of being heavy. They are, however, not affected by liquids, but their advantages over glass are so slight (being somewhat less fragile) that they are not often employed. Earthen-ware funnels, if well glazed, are very useful in filtering *hot liquids*. Enamelled funnels, called granite- or agate-ware, etc., are made from sheet-iron having the surface entirely covered with a glazed composition which resists the action of most chemical substances. If carefully used, they answer for many purposes. Their greatest objection arises from the brittleness of the enamel, which is apt to chip off if the funnel is dropped upon the floor or subjected to a blow; and at the point where the neck of the funnel is joined to the body, the enamel coating is so thin that by constant use and knocking about it is soon chipped off, the exposed iron quickly rusts, and the neck breaks off from the body. Tinned-iron funnels are most largely used, and are popular because of their cheapness; but it is quite possible for a pharmacist to ruin in one operation a preparation

FIG. 246.

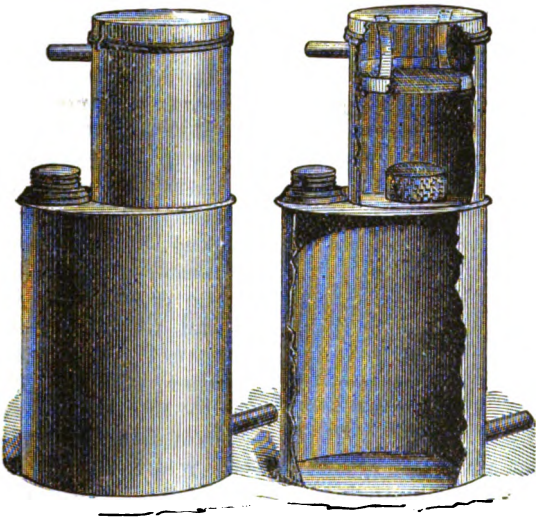


Ribbed funnel.

worth ten times the cost of the funnel by filtering it through a tinned-iron funnel and allowing it to come in contact with the iron exposed by the wearing off of the tinned surface.

Filters for Special Purposes.—In the course of laboratory work it frequently happens that large quantities of liquids require filtering, and the methods suitable for smaller operations cannot be profitably employed: the filtration and purification of water often become necessary. Charcoal in some form is frequently employed, not only on account of its porous character, but also because of its power of absorbing odors and depriving liquids of color. Sand, powdered glass, or asbestos forms an excellent filtering-bed. A very practical and inexpensive charcoal filter is shown in Figs. 247 and 248. It was devised by Dr. Hadden, and is illustrative of a principle in filtration not heretofore treated of in this work,—*i.e.*, *upward filtration*. It is believed by the advocates of upward filtration that great economy is secured by passing the cloudy liquid upward through a filtering-bed, the principle of action being that impurities settle away from the filtering medium by the force of gravity, instead of accumulating upon it and clogging the pores. Figs. 247 and 248 show an external and a dissected view of the filter. A gallon tin can has a short pipe soldered to it near the bottom; the pipe has a piece of perforated tin or gauze soldered over the opening into the can, to keep it from being filled up. This can is filled with clean gravel. The smaller quart can is connected with the lower one by a raised perforated tin diaphragm, and small pieces of charcoal are packed upon the diaphragm; the upper perforated diaphragm is movable, and is intended to keep the charcoal in place. A disk of coarse cotton flannel should be placed on top of the charcoal, to keep the fine charcoal-dust from working through the top to the upper tin can: this is kept in place by a screw-joint and washer such as is often seen on fruit-cans. About an inch from the top of the can is a small piece of pipe for delivering the filtered water. This filter is, of course, intended to be used in cities and towns, or where water is supplied under pressure. Both the supply- and the exit-pipe should be of proper diameter to permit the use of rubber tube for connecting with the water-supply and delivering the filtered water. The filtration of oils is often effected in a similar manner, one of the

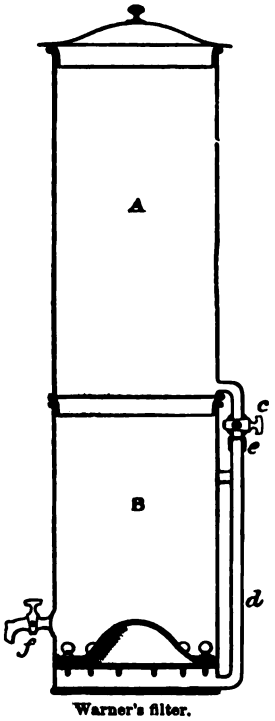
FIG. 247. FIG. 248.



Hadden's filter. Hadden's filter (interior).

earliest applications of this principle being the oil filter or strainer of Wm. R. Warner, of Philadelphia (see Fig. 249). This filter or strainer consists of an upper cylindrical tinned-iron vessel, A, about twenty-two inches high and ten inches in diameter, with a flange-rim soldered on the bottom, of rather less diameter, and about an inch wide, so as to fit firmly into the open top of another cylindrical tin vessel of the same diameter and eighteen inches high. The upper vessel is furnished with a lid, and with a tube and stop-cock, *c*, which penetrates the side close to the bottom, and fits into another tube, *d*, at *e*, which tube opens into the lower vessel close to its bottom and is secured to the side of B by a strong tubular stay. The filtering medium is a cone of hat-felt projecting upward from near the bottom of the lower vessel, and secured by thumb-screws passing through two tinned-iron rings and the felt, which are all properly pierced for the purpose. The stop-cock *c* being closed, the upper vessel is fitted in its place, and the tube-joint *e* rendered tight by wrapping twice around it a strip of isinglass plaster well moistened. When this is dry, the upper vessel is filled with the crude oil, and the stop-cock *e* opened, that the oil may flow into the open space below the filter. A heat of 120° F. is preferred to facilitate filtration or colation, and the filtered oil, as it accumulates in B, should be drawn off, as any large amount greatly retards the process by decreasing the force of the column bearing on the filter. For a pressure filter or strainer, Prof. B. S. Proctor uses a quadrangular cloth filter-bag securely tied to the end of a tin tube five feet long. The extremity of the tube has a wire ring soldered to it, to keep the bag from slipping off.

FIG. 249.



Warner's filter.

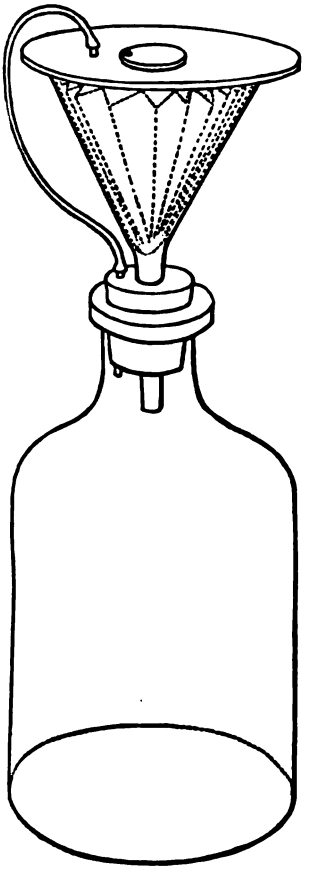
Continuous Filtration.—Most of the expedients used in continuous washing (see page 174) are applicable to continuous filtration.

Filtration of Volatile Liquids.—It is evident that the ordinary methods of filtering liquids will not be practicable for very volatile liquids, because of the loss through evaporation, and the liability to explosion, in the case of inflammable volatile liquids, if brought in contact with flame. Funnels must be covered, and provision made for the escape of the confined air in the receiving vessel. The following method is preferred to the elaborate expedients usually recommended. A glass tube (one of those usually sold as julep-tubes answers very well) is arranged in a glass or metallic funnel, so that the tube will lie close to the side of the funnel and allow one end to project above the filter, but not above the edge of the funnel: it may be held in its place by a ring of absorbent cotton gently thrust into the throat of the funnel. Or a rubber

cover perforated to admit a tube is placed on top, and connection between the bottle and funnel effected as shown in Fig. 250. For larger operations, Dr. Hadden's water-filter or Warner's oil-filter (see pages 189 and 190), slightly modified to suit the liquid, might be used. A very neat method of filtering volatile liquids is provided in the apparatus contrived by E. H. Hance, of Philadelphia. This consists of a cylindrical vessel provided with a tubulure and stop-cock below, and a ground-glass cover above; a flange near the top affords support for a perforated filter-support or funnel containing a filter. When not needed for filtration, the receiving vessel is very useful for many other purposes.

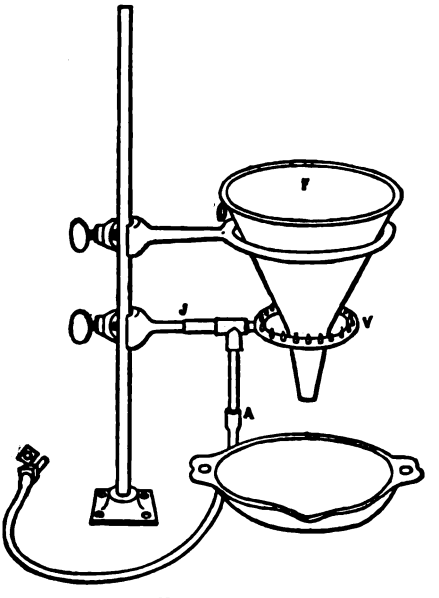
Hot Filtration.—This process is not resorted to as frequently as it might be with advantage, because of the difficulties which are asserted to attend it. These have been greatly overestimated, for by the use of simple, properly-contrived apparatus many preparations which heretofore have been dispensed, bearing an unsightly cloudy appearance, can be greatly improved. Yellow wax is frequently full of mechanical impurities; ordinary straining will not deprive it of these, but it may be filtered through paper and thoroughly purified. Jellies, benzoinated

FIG. 250.



Filtration of volatile liquids.

FIG. 251.

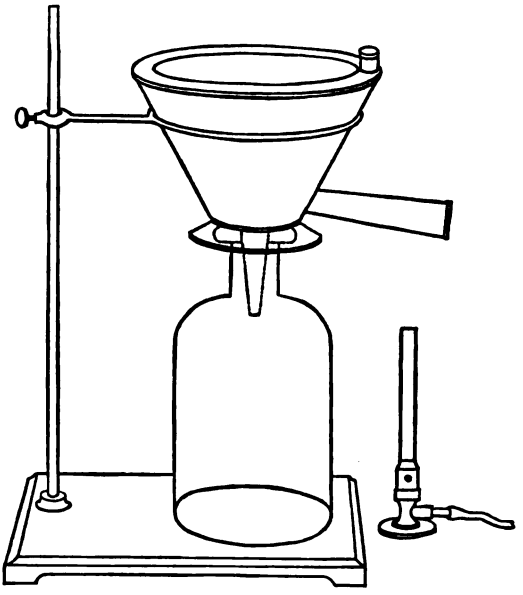


Hot filtration.

lard, petrolatum, cerates, ointments, etc., may thus be filtered. One of the simplest and most easily managed forms of apparatus (see Fig. 251) is made by filing off the ring from one of the ring-supports

of a retort-stand, J, and slipping on to the arm a brass circular jet, V, attached to a tee carrying the gas-supply pipe, A. A tinned-copper or tinned-iron funnel is supported by an appropriate ring at a suitable distance above the jet. The filter is placed in the funnel, a receiving vessel adjusted below, and the hot liquid poured into the filter. It is plain that the liquid can be heated to almost any degree, and the filtration conducted at a much higher temperature (if need be) than by the jacketed hot-water funnel (see Fig. 252), and, on the other hand, the heat may be regulated so that it will be very moderate. The hot-water funnel is an old device, and consists simply of a jacketed funnel having a wide tube soldered at the lowest point, and an opening in the upper edge for the water-supply. A burner or a lamp-flame will heat the water contained between the funnels, and a regulated heat not exceeding that of boiling water is obtained (see Fig. 252).

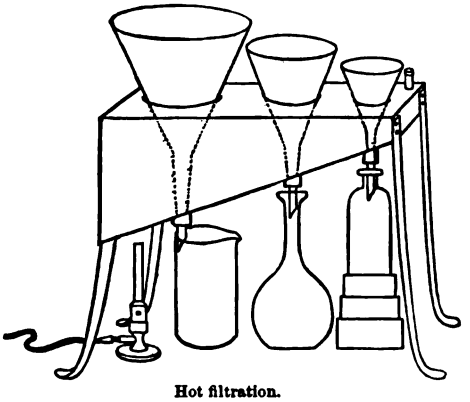
FIG. 252.



Jacketed funnel.

A modification of Dr. Hare's hot-water filter, which permits the use of glass funnels of different sizes, is shown in Fig. 253. It is simply a tinned-copper box, with two sides shaped like a trapezoid, and supported upon four legs. There are three one-inch tubulures in the bottom, and the top has three openings which centre with the tubulures; beginning with the deepest, the diameters are four, three, and two inches. Three glass funnels of different sizes are selected, and the corks for the tubulures in the bottom, having been chosen, are perforated so as to permit the necks of the funnels to pass through and form perfectly tight joints. Water is placed in the box and heated by the burner, as shown in the cut. When

FIG. 253.



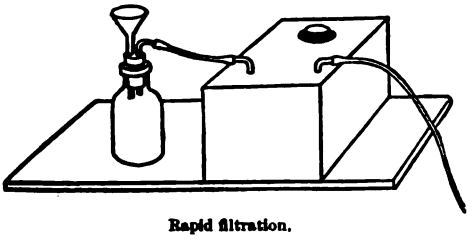
Hot filtration.

not needed for hot filtration, solid corks may be used to close the tubulures, and the box used as a water-bath, covers being placed over the openings which are not in use.

Rapid Filtering Apparatus.—Of late years much attention has been expended upon methods of increasing the rapidity of filtration. Most of the plans suggested depend upon the principle of filtering into a partial vacuum, but the means used to obtain this vacuous space are very varied. A simple method, applicable to operations on the small scale, consists in fitting a good cork to a wide-mouthed bottle and perforating it so that the neck of a funnel will accurately pass through it; another perforation permits the insertion of a piece of glass tube of small diameter. A plain filter of well-washed coarse linen or muslin cloth is then carefully adjusted in the funnel, and a plain filter of paper placed upon it. The liquid is poured upon the filter, and, a rubber tube having been fitted to the glass tube, suction is applied by the mouth. By pinching the rubber tube a partial vacuum is maintained in the bottle, and filtration is hastened. An improvement upon this would be to use a rubber stopper instead of cork, and instead of pinching the rubber tube to use a screw pinch-cock.

Water-Pumps acting by a Fall of Water.—One of the first practical efforts made in the direction of using water-power was seen in Bunsen's pump. The action depends upon the principle that a column of water descending through a tube from a height is capable of sucking with it the air contained in a lateral tube, if the latter is properly arranged. A cheap home-made apparatus, which depends upon a fall of water for its usefulness, is shown in Fig. 254. It consists of a common wide-mouthed half-gallon jar, and a tinned-iron can holding three, four, or five gallons; a castor-oil can answers very well. The screw-cap is for readily filling the can; the exhaust-pipe on the right reaches inside of the can, nearly to the bottom, the other tube is soldered on the head of the can connecting with the interior. The jar, having a funnel fitting into it through an air-tight stopper, is connected with the can by means of a bent glass tube and rubber tube. The can is filled with water, and the solution to be filtered is placed in the funnel. The exhaust-pipe is connected with a rubber tube eight or ten feet long and a quarter of an inch in diameter (the longer the tube the more rapid is the filtration). When the

FIG. 254.



Rapid filtration.

FIG. 255.

Lux's aspirator.

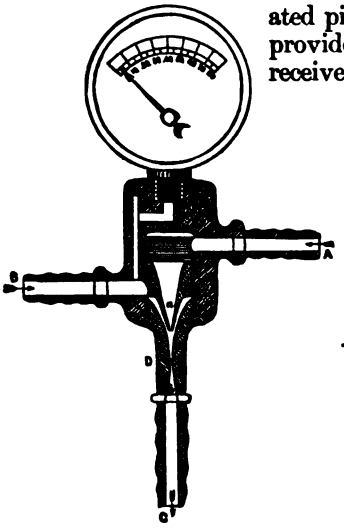
FIG. 256.

Rapid filtration.

syphon thus formed is started, the flow of the water from the can carries with it the air from the bottle. (N. R., 1881, p. 266.)

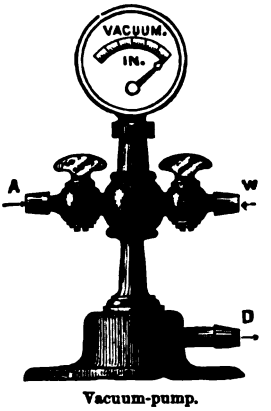
Lux's aspirator (see Fig. 255) is constructed by fitting two accurately-perforated rubber stoppers to the ends of a piece of wide glass tubing; four short glass tubes are inserted in the stoppers, as shown in the cut. One of the tubes is for the supply of water, another carries it off, the third tube is connected with the vessel to be exhausted, whilst the fourth tube may be put to the same use, or connected with a vacuum gauge or closed with a stopper. If the air is to be aspirated by one of the lower tubes, the vessel to be exhausted must stand on a higher level than the aspirator. The length of the exit-tube determines the power of the aspirator. It should have a bore of one-fifth of an inch and be at least ten feet long, and it should be provided with a screw pinch-cock to regulate the flow of water. A very simple apparatus is shown in Fig. 256. A very moderate fall of water is needed here. It is, however, adapted only to small operations. Two rather large bottles, of equal capacity, and both provided with nipples near the bottom, are selected. Into the neck of each is fitted a tight-fitting stopper carrying a glass tube bent at a right angle, and the nipples near the bottom are connected with a rubber tube. A Woulffe's bottle having two necks is next selected, and one of the necks fitted with a tight-fitting stopper carrying a small bent tube, to which is attached a rubber tube provided with a conveniently situated pinch-cock. The other end of the bottle is provided with a stopper so perforated that it will receive air-tight a glass funnel. One of the large bottles is filled with water and placed on an elevated shelf, when the water will flow down to the other bottle: and if the connections are made as shown in the cut, it will aspirate through the funnel; and if the funnel is full of liquid, it will cause the latter to run through quite rapidly. When the lower bottle is full, it is substituted for the upper one, and the connection with the vessel to be exhausted, transferred to it.

FIG. 257.



Fisher's vacuum-pump.

FIG. 258.



Vacuum-pump.

Water-Pumps acting by Pressure.—It is usually inconvenient to operate aspirators which depend upon a fall of water through a long tube, except in high buildings: hence water-pumps which are operated by pressure are generally preferred in cities and towns, or in localities where water is supplied under pressure. The following are selected

from the great variety in use as being good illustrations of the principle. Those made of glass are not recommended, because of their extreme liability to breakage. Fisher's vacuum-pump is well shown in Fig. 257. A, B, C, are intended to receive rubber tubing, and the neck, D, may be fastened by a clamp to a retort-stand or other upright fixture. Water from the hydrant enters at A, passes through the nipple at *a*, and, being forced through the contracted portion, *b*, draws with it the air from the tube, B, which is attached to the filter. A communication is also made with the vacuum-gauge, as shown in the cut, to mark the degree of exhaustion. Schutté and Goehring, of Philadelphia, have contrived a similar apparatus, which is somewhat more convenient from their having placed it upon a base and deflected the lower tube laterally. This permits the use of the apparatus in many places where Fisher's pump could not be used. It is shown in Fig. 258. W represents the water-supply tube, D the outlet, and A the aspirating tube.

CHAPTER XII.

CLARIFICATION AND DECOLORATION.

Clarification is the process of separating from liquids, without the use of filters or strainers, solid substances which interfere with their transparency. The processes of clarification and decoloration from a pharmaceutical point of view have declined in importance of late years, owing to the fact that chemical and other substances requiring the processes are supplied in a purified condition so cheaply that it is absolutely impossible for the pharmacist to compete with the manufacturer who operates on the large scale and uses apparatus and methods which are thorough and economical. This is particularly the case with sugar and the alkaloids. Formerly the apothecary bought raw sugar and clarified the syrup; now the difference in price between raw sugar and that which is pure is so slight that no one ever makes syrup from raw sugar. The decoloration of alkaloidal solutions and the manufacture of alkaloids cannot be economically attempted on the small scale by the pharmacist, because of the want of continuity of the process; the manufacturer, on the other hand, can use the animal charcoal repeatedly until its power is exhausted, and in other ways practise economy not possible to the apothecary. It is, nevertheless, very important for the student to comprehend thoroughly the principles underlying both processes.

Clarification may be effected in several ways:

1. By the application of heat. 2. By increasing the fluidity of the liquid. 3. Through the use of albumen. 4. Through the use of gelatin. 5. Through the use of milk. 6. Through the use of paper pulp. 7. By fermentation. 8. By subsidence through long standing.

1. *By the Application of Heat.*—When a viscid liquid is heated, its specific gravity is diminished, and frequently particles which were suspended in it, and interfered with the transparency of the liquid, will separate, the heavier ones falling to the bottom, and the lighter ones rising; in the latter case, ebullition facilitates the separation, the minute bubbles of steam becoming enveloped in the viscid particles rise through their buoyancy, and a scum is formed which may be readily separated. The officinal process for the clarification of honey (Mel Despumatum) is a good illustration of the use of heat in this connection.

2. *By Increasing the Fluidity of the Liquid.*—Clarification by this method depends upon decreasing the specific gravity of the liquid by the addition of water, alcohol, or other liquid lighter specifically than

the one to which it is added: this causes the suspended particles to subside, and the clear liquid may then be decanted.

3. *The Use of Albumen.*—The property possessed by albumen of remaining liquid at ordinary temperatures and becoming coagulated by heat renders it one of the most useful substances that can be employed in the process of clarification. Its action is mechanical, and where albumen exists naturally in the liquid, as in many fruit and vegetable juices, the simple heating of the liquid suffices to coagulate the albumen, which envelops the particles that render the liquid cloudy, and these rise to the top and are skimmed off. Albumen, or white of egg, is frequently added to liquids to clarify them; in such cases it should always be added before the liquid is heated: this is best accomplished by adding about an equal bulk of the liquid to the albumen, then introducing the mixture into a muslin strainer and squeezing it through the meshes of the cloth by gathering up the corners and spirally twisting the strainer, when the organization of the albumen is destroyed, and a smooth mixture results; the strained solution is then added to the liquid to be clarified, and the whole heated gradually (usually until it boils), without stirring, until coagulation is effected. In most cases the white of one egg is sufficient for a gallon of liquid: the error most frequently made by operators is the use of an excess of albumen. Care must be taken not to use albumen as a clarifying agent in those cases where the active principle of a liquid forms a precipitate with albumen by combining with it.

4. *The Use of Gelatin.*—Gelatin is used when tannin is present and is the cause of cloudiness, or when it is desirable for other reasons to remove it: its action depends upon the fact that gelatin forms with tannin an insoluble compound; this is, indeed, the basis of leather. Isinglass, one of the purest kinds of gelatin, is the preferred form; it is frequently employed for clarifying infusions containing tannin, such as tea and coffee, etc. It is used by adding a weak solution of the gelatin in hot water to the liquid before it is heated, and allowing the liquid to cool. The insoluble compound formed must always be strained or filtered out.

5. *The Use of Milk.*—The presence of casein in milk, and the fact that acids precipitate it in the form of a curdy precipitate, are taken advantage of in the use of milk as a clarifying agent. It is employed particularly for vinous preparations, sour wines, etc., and should not be used in excess.

6. *The Use of Paper Pulp* does not depend upon chemical combination, its action being purely mechanical. Paper pulp for filtering is best prepared by placing filtering-paper (the saved trimmings and scraps left from making filters answer well) into a mortar or other vessel, and pouring enough solution of soda or potassa on it to soak it, then stirring it with the pestle until it is reduced to a pulp. This should then be washed by placing a loose plug of absorbent cotton in a funnel and pouring in the mixture: when it has drained, water (preferably hot) should be poured upon it until all traces of alkalinity are washed out; the purified pulp may then be placed in wide-mouthed bottles until needed. It is used as a clarifying agent by adding a portion to the

cloudy liquid, agitating the mixture, and allowing the whole to stand quietly until the liquid is clear; or, as a filtering agent, after the addition of the pulp, the mixture may be thrown upon a wetted muslin strainer, and if the liquid which passes through at first is not clear, it may be returned until it is. It will be found that the particles of pulp will partially fill up the meshes of the strainer, and an excellent filtering-bed is thus formed: care should be taken, therefore, not to stir the mixture up after it is placed on the strainer.

7. *By Fermentation.*—The changes in the composition of juices after they have been fermented usually lead to the deposition of those substances which previously interfered with the transparency of the juices; the generation of alcohol through fermentation produces a liquid in which the substances are insoluble, hence the formation of a deposit. The officinal preparation of syrup of raspberry affords a good illustration of the principle of clarifying juices by fermentation, whilst in the manufacture of wines the principle has been known and practised for centuries.

8. *By Subsidence through long standing.*—This method involves the least possible amount of labor and expense, and it is resorted to very frequently (particularly upon the large scale) when haste is unnecessary, and whenever the liquid keeps well enough to withstand the tendency to spoil during the time necessary to effect complete separation. The deposit formed is called a *sediment:* this term is not synonymous with *precipitate. Sediment is solid matter separated merely by the action of gravity from a liquid in which it has been suspended. A precipitate, on the other hand, is solid matter separated from a solution by heat, light, or chemical action.* The fixed oils are clarified by subsidence; in the vegetable oils the sediment consists principally of albuminous and gummy substances which have been separated with the oil during the process of expression.

Decoloration is *the process of depriving liquids or solids in solution of color by the use of animal charcoal.* Decoloration is used in the abstraction of coloring-matter from fatty bodies, oils, petrolatum, syrups, honey, etc. Animal charcoal, or bone-black, which is produced by heating bones in close vessels out of contact with air, and then grinding them, is generally preferred in decolorizing operations. Wood charcoal possesses but little power in this direction. It has been generally settled that the decolorizing property is owing to the formation of insoluble compounds of the coloring-matter when it is brought in contact with porous charcoal. Animal charcoal varies greatly in its power. The officinal purified animal charcoal is often not so powerful as a decolorizer as the animal charcoal from which it was made; but bones contain calcium phosphate and calcium carbonate, and the object of the purifying process is to abstract these salts, because, in many of the delicate operations of pharmacy, particularly the decoloration of vegetable acid solutions, these salts would be dissolved by the acids, and the solutions thus contaminated. The most powerful animal charcoal is produced by calcining dried blood and other animal matter with pearl-ash, and afterwards washing out the pearl-ash with water, and subsequently with an acid solution: the charcoal need not be dried before using. For other

information about the properties of charcoal, see *Carbo Animalis* and *Carbo Animalis Purificatus*, U. S. Dispensatory, 15th edition, pp. 352–355. For most decolorizing operations of the pharmacist on the small scale, the solutions, melted fats, oils, etc., can be introduced directly upon the animal charcoal, which is placed in a funnel and prevented from falling through by the insertion of a plug of absorbent cotton, or it may be arranged in an ordinary percolator, and the cold liquid percolated through the charcoal, or the liquid simply agitated with the charcoal and the mixture filtered. It is very important to remember that charcoal absorbs a number of valuable principles used in medicine, —*e.g.*, *bitter substances*, like gentiopicrin, aloin; *astringents*, like tannin; *alkaloids*, like quinine, morphine, strychnine, cocaine, etc. Charcoal has even been used as an antidote for poisoning with the alkaloids. It should always be used with discrimination and judgment, or it may be found that in striving to improve the appearance of a preparation by lessening the color its value has been sacrificed.

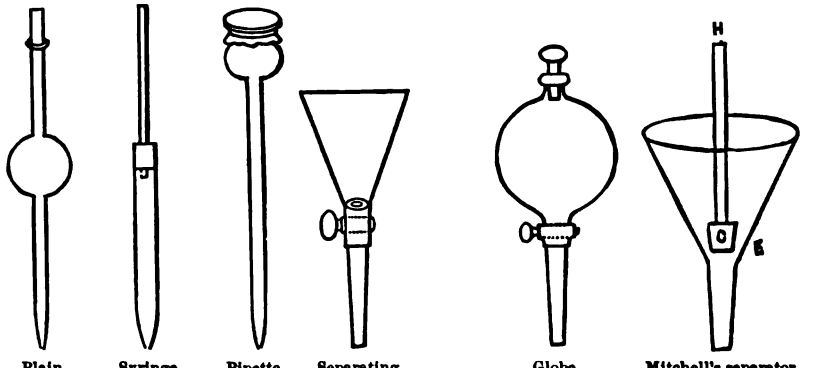
CHAPTER XIII.

SEPARATION OF IMMISCIBLE LIQUIDS.

THE separation of liquids which are mutually soluble is usually effected by distillation, if one or both of the liquids are volatile (see page 117); but the separation of liquids which do not mix with each other is generally a simpler process, and the object of this chapter is to show the methods at present in use.

Use of the Pipette.—This simple instrument consists of a narrow tube with its lower end drawn out to a capillary orifice, and a bulb, either globular or elongated, blown in it near the top; the upper edge is usually surrounded by a smooth glass ring to strengthen it. It is used by dipping the lower orifice into the liquid that is to be separated and applying suction with the mouth at the upper end; the liquid rises, fills the bulb, and, if the end of the moistened forefinger is applied to the top, the liquid may be carried some distance without running out. Fig. 259 shows the ordinary form of the instrument. Fig. 260 can be readily made from a glass syringe-tube, a perforated cork, and a piece of tube, by one unskilled in glass-blowing. Fig. 261 shows a pipette which has a piece of sheet-rubber tied over the thistle-shaped top. If pressure is ap-

FIG. 259. FIG. 260. FIG. 261. FIG. 262. FIG. 263. FIG. 264.



Plain pipette. Syringe pipette. Pipette. Separating funnel. Globe separating funnel. Mitchell's separator.

plied to the rubber, the air is partially exhausted and a slight vacuum produced; if the point of the pipette is then applied to the liquid and the pressure relaxed, the liquid will rise, and it may be transferred to another vessel. A modification of this, where a rubber bulb is attached to the pipette and used in a similar manner, is seen in Fig. 36.

Use of the Glass Syringe.—The glass ear-syringe, having a bulb

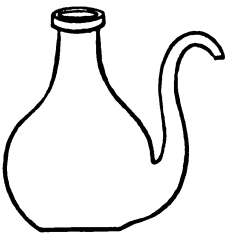
blown near the orifice, is very useful in collecting a small quantity of oil floating on top of a liquid contained in a beaker or open vessel. The piston of the syringe should be well soaked in warm water before attempting this simple but delicate operation.

Use of the Separating Funnel.—This instrument, as indicated by its name, is used to facilitate the separation of immiscible liquids. It is generally a funnel having a glass stop-cock in its neck (see Fig. 262). The mixed liquid is poured into the funnel, which is placed in position where it can come to rest, and the lower liquid is then allowed to run off by opening the stop-cock. With careful use, liquids can be separated with great accuracy in this way. Where the liquid is valuable or very volatile, as in some of the oils, the globe separator (see Fig. 263), which can be accurately closed and evaporation prevented, is preferred.

Mitchell's Separator.—Dr. Mitchell devised a cheap but efficient substitute for the separating funnel (see Fig. 264). A good cork, C, is fitted into the throat of a funnel, E, and the end of a penholder-handle, H, or other suitable wooden rod, is whittled to a flat wedge, and this forced into the cork tightly. The lower portion of the holder is notched, and the upper part of the cork is tied securely to it, or a pin may be driven through it and the cork to fasten it: it is used by forcing the cork C into the neck of the funnel, pouring in the liquids, and, when they have separated, lifting the handle H carefully until the lower liquid has entirely escaped, and then pushing it down tightly to stop the flow.

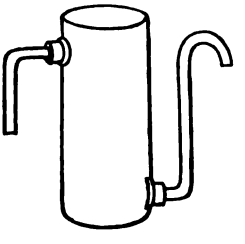
Florentine Receiver.—The separation of volatile oils from the water which usually accompanies them during distillation is a very important part of their process of manufacture. Where the volatile oil is lighter than water, the form shown in Fig. 265 is used. The mixed oil and water collect in the glass receiver during distillation, the oil floating on the top, whilst the water ascends the bent tube from the bottom; further addition of distillate causes an overflow, and the water from the bottom of the receiver is discharged through the tube into a suitable vessel; then the receiver becomes filled again gradually as distillation progresses. The process of separation is continued automatically. Where the oil is heavier than water, the method is reversed, and provision must be made for the escape of the water near the top of the receiving vessel. Labor may be saved by the use of a long-necked funnel, or by placing a funnel in a wide tube, so that the mixed oil and water may be conveyed at once to the bottom without the liability of some particles of oil being carried over through the lateral tube and necessitating a second separation.

FIG. 265.



Florentine receiver.

FIG. 266.



Receiver for heavy and light oils.

Fig. 266 shows a receiver which can be used for either light or heavy oils, one or the other tube being stopped with a cork, as the case requires.

CHAPTER XIV.

PRECIPITATION.

PRECIPITATION is the process of separating solid particles from a solution by the action of heat, light, or chemical substances. The separated solid is termed a *precipitate;* the added liquid or substance which produces the precipitate, the *precipitant;* the liquid which remains in the vessel above the precipitate, the *supernatant liquid.*

The precipitate usually falls to the bottom of the vessel. It may, however, remain suspended or rise to the top.

The objects of precipitation in pharmacy are,—

1. To obtain conveniently solid substances in the form of fine powder. Example, the precipitation of calcium carbonate.

2. To effect the purification of solids. Example, the precipitation of pepsin from its solution by sodium chloride.

3. To obtain through chemical reaction substances which are insoluble in the supernatant liquid. Example, the officinal preparation of red iodide of mercury.

Precipitation is largely used in testing, as it frequently affords the most ready means of recognizing chemical substances or of ascertaining their purity. A great many pharmacopœial tests are based upon this process. The color, quantity, and character of the precipitate are all taken into account. The terms *curdy, granular, flocculent, gelatinous, crystalline, bulky,* and others, which are sufficiently distinctive, are used to define the peculiar form which the precipitate assumes when thrown out of solution. A *magma* is a thick, tenacious precipitate left after the liquid is decanted.

Methods of Effecting Precipitation.—Precipitation may be produced in many ways. If solutions containing albuminous matter be *heated,* a flocculent precipitate of coagulated albumen will be thrown down; whilst if solution of the silver salts be exposed to the *light,* precipitation is apt to take place. Precipitation will usually occur when a hot saturated solution of an amorphous substance is allowed to cool, as in the preparation of oxysulphide of antimony, or when to a solution is added a liquid in which the dissolved substance is insoluble, as when strong alcohol is added to a small quantity of mucilage of acacia, or water to an alcoholic solution of resin.

Precipitation is most generally effected by the reaction of chemical substances, and some of the most interesting processes in pharmacy are the results of this method of producing precipitates. When acid solutions are brought in contact with alkaline solutions, insoluble precipitates are sometimes formed, as the solution of oxalic acid with lime water, form-

ing calcium oxalate. By far the most common method is to mix a solution of one salt with a solution of another, thereby producing an insoluble precipitate, as in the officinal process for preparing mercuric iodide, where solution of mercuric chloride is added to solution of potassium iodide. The methods of producing precipitates are numerous, and will be noted in detail under the head of the respective substances.

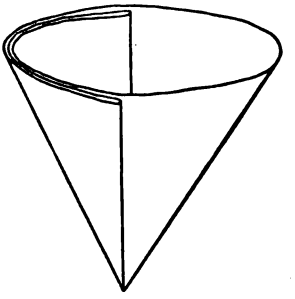
Vessels used in Precipitation.—Precipitating vessels should be deep, comparatively narrow, and broader at the bottom than at the top (see Fig. 267). This construction permits the precipitate to occupy less height in the vessel, by causing it to spread out upon the bottom; thus the supernatant liquid can be more thoroughly decanted off, the particles of the precipitate will lie in closer contact, and a better opportunity is given for the escape of imprisoned air or gas, which frequently exercises a buoyant effect on the particles and prevents their subsiding rapidly and closely. Upon the large scale, cedar tanks, of the shape just described, may be used: these may have wooden spigots introduced, a foot or so apart, so that the supernatant liquid may be conveniently run off.

FIG. 267.

Precipitating jar.

Manner of conducting the Process.—If two solutions are used, and it is known that they contain the exact quantity of solid substance to react mutually without leaving an excess of one or the other, the order in which the liquids are mixed is immaterial; but when this is not the case, and the precipitant is to be added until precipitation ceases, it is necessary to proceed with caution. The precipitant is then added gradually, and, where acid or alkaline solutions are used, litmus-paper is useful in indicating the approach of an excess. In other cases the precipitate may be allowed to subside, and the precipitant slowly dropped into the clear liquid above until it is noticed that further addition is without effect. If the precipitate is too bulky to subside quickly, the whole may be vigorously stirred until thoroughly mixed, a small portion transferred to a small plain filter, and the filtrate tested by a further addition of precipitant. If this small portion is weighed, or measured, or is a known proportion of the whole, a simple multiplication will determine about the quantity necessary to complete the precipitation. Water of ammonia is one of the most useful of alkaline precipitants, because an excess is at once noticed by the odor. This is easily done by blowing the air from the surface of the liquid, thoroughly stirring up the mixture, and then noting whether it smells of ammonia.

FIG. 268.



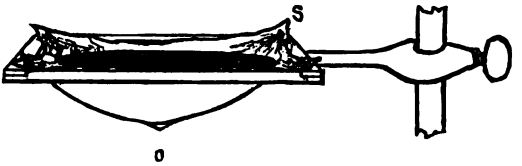
Plain filter.

The Production of Heavy and Light Precipitates.—Hot, dense solutions usually produce heavy precipitates, and such precipitates are more readily washed from adherent contaminating salts than those which are light and bulky. An additional advantage is, that they oc-

cupy less space, and consequently their dose is less bulky. A good example of this is found in the manufacture and use of heavy and light magnesium carbonate.

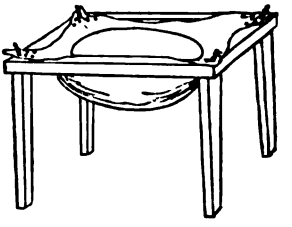
Collecting and Washing Precipitates.—In small operations precipitates are collected upon plain filters (see Fig. 268): the special advantages of such filters in this respect have been already pointed out on page 182. On a larger scale muslin strainers are generally used. These are suspended on frames, as shown in Figs. 269 and 270. In washing precipitates which

FIG. 269.



Collecting a precipitate.

FIG. 270.



Frame and strainer for precipitates.

are placed on strainers of this kind, care must be observed to close up the fissures which usually appear in the magma after it has been allowed to stand a short time, by stirring the precipitate thoroughly before adding more water. (See Lotion, Decantation, pages 173, 175.)

CHAPTER XV.

CRYSTALLIZATION.

CRYSTALLIZATION is the process whereby substances are caused to assume certain determinate forms called *crystals*. These are distinctive, and when perfect are bounded by geometrical surfaces. Those substances which are *not* crystallizable are termed *amorphous*. The objects of the process are to increase the purity and to enhance the beauty of chemical substances. The descriptions of the crystalline forms assumed by bodies form the basis of the interesting science of *crystallography*. In a work of this kind it is impossible to give more than a very brief sketch of the outlines of the classification, since the practical process of crystallization must receive the most attention. (See Dana's Mineralogy, Kopp's Krystallographie, Miller's Mineralogy, etc.) Every crystallizable body invariably assumes its own characteristic form, or some form directly derived from it or related to it by a simple law, and in order to classify them crystallographers recognize at the present time six systems, to one or other of which every crystal is referred. A seventh system is sometimes conceded, but the occurrence of crystals belonging to it has not been demonstrated with certainty.

The following definitions should be well understood: The plane surfaces bounding a crystal are termed *faces;* when two contiguous faces intersect, an *edge* is formed; an *angle* is formed when three or more faces intersect.

The faces, edges, or angles of a perfect crystal have equal faces, edges, or angles opposite to them, and if the middle point of the opposite faces or edges, or the opposite angles, be joined by straight lines, the point at which these lines intersect will be the centre of the crystal. The lines drawn through this point are called *axes*.

When *the same* body crystallizes in two or more forms belonging to different systems, it is said to be *dimorphous, trimorphous, polymorphous*, etc. When *different* substances crystallize in the same form, they are said to be *isomorphous*.

Prismatic (or prism-like) *crystals* are those which are extended principally in the direction of their longest axis. *Tabular crystals* are those crystallizing in flat plates; *laminar*, those crystallizing in thin plates; *acicular*, those which are needle-shaped, etc.

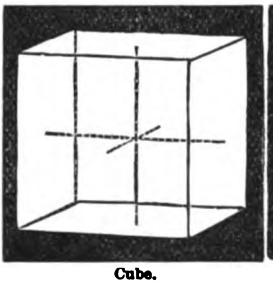
Other terms are used to describe the physical characters of crystals, which are readily understood and are not technical in their meaning.

The systems of classification are based upon the length and relative position of the axes of the crystal. Those in which the three axes intersect at right angles are termed *orthometric;* and when the angles caused by their intersection are oblique, they are called *clinometric*.

SYSTEMS IN CRYSTALLOGRAPHY.

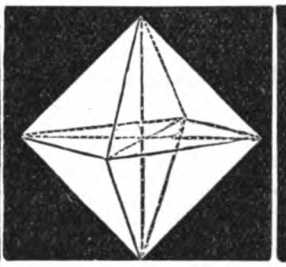
I. Monometric, or Regular System.—The crystals have three axes of *equal* length intersecting at right angles (see Figs. 271, 272, and 273).

FIG. 271.



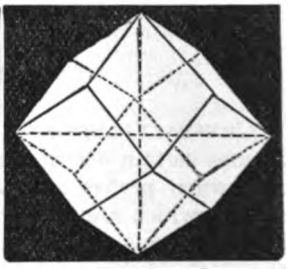
Cube.

FIG. 272.



Octahedron.

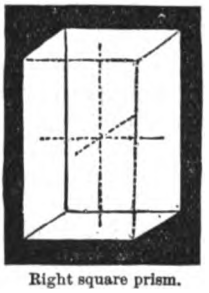
FIG. 273.



Rhombic dodecahedron.

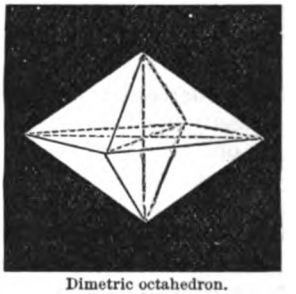
II. Dimetric, or Quadratic System.—The crystals have three axes,

FIG. 274.



Right square prism.

FIG. 275.

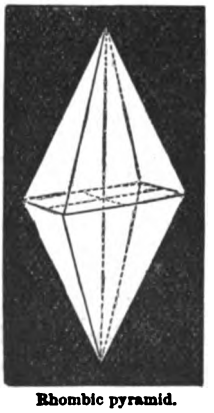


Dimetric octahedron.

two of which are *equal*, the other *different* in length, all intersecting at right angles (see Figs. 274 and 275).

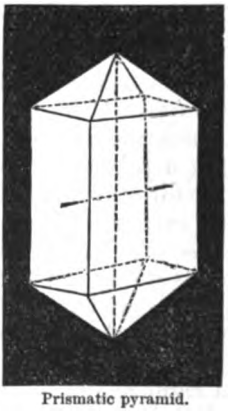
III. Trimetric, or Rhombic System.—The crystals have three axes

FIG. 276.



Rhombic pyramid.

FIG. 277.

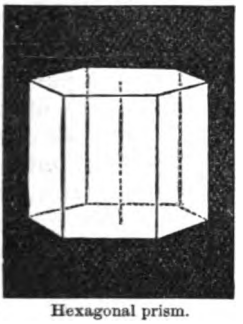


Prismatic pyramid.

of *unequal* length, all intersecting at right angles (see Figs. 276 and 277).

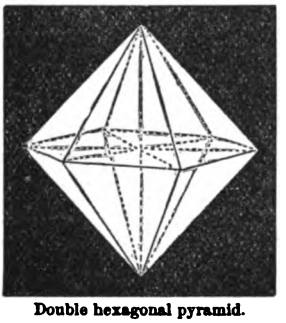
IV. Hexagonal, or Rhombohedric System.—The crystals have four axes, three of *equal* length, in the same plane, and inclined to one another at angles of 60°. The fourth axis is *different* in length, and intersects the plane of the other three at right angles (see Figs. 278 and 279).

FIG. 278.



Hexagonal prism.

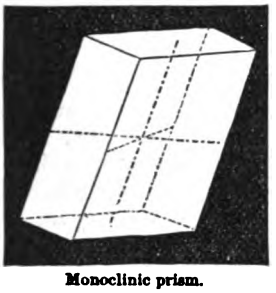
FIG. 279.



Double hexagonal pyramid.

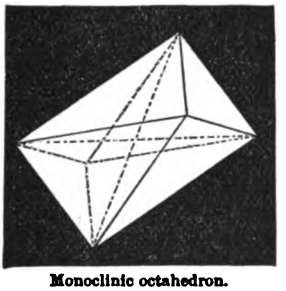
V. Monoclinic, or Oblique-Prismatic System.—The crystals have three axes of *unequal* length, two of which are obliquely inclined to

FIG. 280.



Monoclinic prism.

FIG. 281

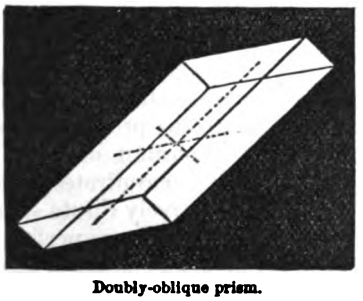


Monoclinic octahedron.

each other, the other axis forming right angles with these two (see Figs. 280 and 281).

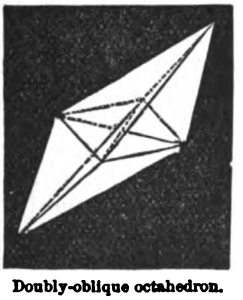
VI. Triclinic, or Doubly-Oblique Prismatic System.—The crystals

FIG. 282.



Doubly-oblique prism.

FIG. 283.



Doubly-oblique octahedron.

have three axes of *unequal* length, all obliquely inclined to one another (see Figs. 282 and 283).

The Diclinic System, if recognized, would have three axes, two at right angles to each other, the third oblique to the other two.

Determination of Crystalline Form.—The method of determining the position of a crystal in one or other of the systems above noted is to measure the inclination of the angles which the faces of the crystal make with one another. From the data obtained the length and inclination of the axes are calculated. The hand goniometer or Wollaston's reflecting goniometer is used to measure the angles.

Cleavage.—If a crystal of potassium ferrocyanide or a piece of mica is broken and examined, it will be noticed that the cohesion of the particles is less in one direction than in any other, and if the blade of a knife is inserted in the edge, the crystal may be easily split or cleft. Other crystals possess this property, but to a greatly varying extent. Perfect crystals may sometimes be formed by cleavage.

The Process of Crystallization generally takes place when a body passes from a liquid or a gaseous condition into the solid state: a few instances are known where amorphous solids become crystalline without becoming liquefied, as in iron or brass wire, sulphur, barley-sugar.

Methods of Obtaining Crystals.—1. By fusion and partial cooling. 2. By sublimation. 3. By deposition from supersaturated solutions as they cool. 4. By deposition from solutions during evaporation. 5. By deposition from solutions upon passing through them a galvanic current. 6. By precipitation. 7. By the addition of a substance having a strong affinity for water.

1. **By Fusion and Partial Cooling.**—Substances which have low melting-points, like sulphur, camphor, and iodine, and some of the metals, like bismuth, antimony, etc., may be crystallized in this way. To obtain crystals of a substance like sulphur, it should be melted in a deep vessel and then allowed to cool, so that a crust will be formed; a hole is then made in the crust, and a smaller one on the opposite side; the vessel is now inclined towards the side having the larger hole, and the melted substance runs off; when the surfaces inside are examined, they will be found studded with crystals. If the quantity of material used is large, and the mass has been gradually cooled, the crystals will be large and distinct. The crust should be perforated as soon as it is fairly formed, and the fluid contents quickly removed.

2. **By Sublimation.**—This is one of the most useful methods of obtaining crystals (see Sublimation, page 140).

3. **By Deposition from Supersaturated Solutions.**—This is the method by far most frequently employed to obtain crystals. The solution of the substance is generally effected by the use of heat (see Solution): it should be carefully filtered, and evaporated to the proper degree, and this latter part of the operation is the most important in determining the size and beauty of the crystals. As a rule, concentrated solutions produce small, ill-defined crystals, whilst comparatively dilute solutions, provided they are supersaturated, produce crystals of more perfect form. The proper degree of concentration must always depend upon the solubility of the substance: if very soluble, the solution should not be saturated at the boiling temperature, or the crystals will be very small and so thoroughly interlaced that it will be difficult to wash them; if a por-

tion of the evaporating solution is transferred to a glass or porcelain plate and allowed to cool, the rapidity with which the small quantity of solution crystallizes, and the amount of crystals obtained, form a basis for judgment. Upon the large scale, in order to secure a uniform product, it will be found that the specific gravity of the solution at a definite temperature, the temperature of the air, and the quantity of the solution must be considered: these points, however, can be obtained only by experience, and after a practical trial with each substance. It is a good habit to keep a record at each operation of the specific gravity and temperature of the solution which is set aside to crystallize, and note the character of the product. If the substance is not very soluble, the solution should be evaporated until a *pellicle* or crust is formed upon the top, and then set aside.

Perfect Rest for a solution designed for crystallization must be secured, if well-defined crystals are wanted, and the solution must not be cooled quickly. When small crystals are desired, as in the case of magnesium and zinc sulphate, the solution should be cooled quickly, with constant agitation: this produces a great many nuclei, and prevents the gradual deposition of the particles in regular order upon one nucleus, which is so essential to the formation of the perfect crystal. There are several plans to choose from, for preventing rapid cooling: if the liquid is placed in an evaporating dish, and heated in a sand-bath or water-bath until evaporated to the proper point, the whole may be set away without disturbing them, to cool slowly together; or the dish may be placed in a warm room which is slowly cooled; or it may be embedded in a blanket or in woollen cloths, covered, and set aside. Having arranged the dish, it must be left absolutely undisturbed until all the crystals have separated: if jarred or knocked after the crust has once formed, the crystals will be mere confused masses.

Use of Nuclei.—It has long been known that if a smooth glass rod having a single scratch upon it be placed in a solution ready to crystallize, crystals will first attach themselves to the scratched part, and the smooth part of the rod will frequently not have any separate crystals upon it. Rough surfaces, by offering more points of adhesion, attract the nuclei upon which the crystalline body is subsequently deposited: it is for this reason that strips of wood or lead are frequently suspended in liquids intended for crystallization, whilst in the manufacture of rock-candy, threads are usually strung across the crystallizing-tubs at regular intervals, columnar masses of fine crystals being thus produced. Perfect geometrical crystals may be obtained by the practice of "nursing," which consists in selecting from the ordinary stock as perfect a crystal as can be found for the nucleus, and then suspending it by a horse-hair or piece of sewing-silk in a warm saturated solution of the salt. Prof. J. U. Lloyd contributed to New Remedies, in 1879, pp. 98, 133, 162, some interesting notes on the production of perfect crystals.

Retarded Crystallization.—Warm saturated solutions of various salts, particularly if contained in chemically clean vessels, protected from the dust, and left at absolute rest until cooled, usually fail to crystallize. If the receptacle is shaken or jarred, or if a crystal from which the solution has been made, or any other solid substance, is dropped into it, crystal-

lization sometimes takes place in an instant, and considerable heat is evolved: this is particularly noticed with salts capable of crystallizing with more than one molecule of water, as sodium sulphate, sodium carbonate, etc.

4. **By Deposition from Solutions during Evaporation.**—This process is not so frequently resorted to as that of cooling from hot saturated solutions, but it is especially useful where the liquid is more volatile than water, as alcohol, ether, benzin, chloroform, and upon the small scale for experimental purposes, or in the processes of original investigation. There are some instances in manufacturing pharmacy where the method is used, but in the case of volatile liquids the expense attending their loss, if spontaneously evaporated, is great, and, as a usual thing, rapid evaporation or recovery of the solvent by distillation cannot be used where large and distinct crystals are desired. Beautiful crystals are often made from aqueous solutions of substances that are allowed to evaporate slowly in a warm room for several months. The quantity of liquid and the amount of solid in solution have a great influence in enhancing the beauty of the product: for this reason it is usually impossible for the pharmacist operating on the small scale to vie with the manufacturer in producing massive crystals; there is compensation, however, to the pharmacist in obtaining increased knowledge of the properties of medicinal chemicals and absolute knowledge of their purity.

5. **By Deposition from Solutions upon passing Feeble Electrical Currents through them.**—This method is mentioned in this connection because Becquerel and others have produced crystals of metals and metallic oxides by the slow but continuous action of feeble electrical currents through the solutions, kept up for months, sometimes for years. Gold and copper may be beautifully crystallized in this way.

6. **By Precipitation.**—Crystals are produced in some cases by the precipitation resulting from the mixture of certain solutions, and in other ways. (See Precipitation.) The crystals formed by this method are granular, and, on account of their rapid growth, are not well defined. A crystalline precipitate of acid tartrate of potassium is produced when solution of potassa is added to a strong solution of tartaric acid.

7. **By the Addition of a Substance having a Strong Affinity for the Liquids of the Solution.**—This method of effecting the crystallization of a solid is resorted to in some special cases. If calcium chloride is added to an aqueous solution of sodium chloride, the latter crystallizes out. Alcohol mixed with a solution of potassium nitrate causes the crystallization of the salt, because alcohol and water unite, and the potassium nitrate is not soluble in the mixture. The crystallization of sugar is frequently observed in syrups to which alcohol in the form of a tincture or fluid extract has been added, and this is often a source of annoyance to the pharmacist.

Water of Crystallization.—Many substances in the act of crystallizing combine with water, and the water so combined is termed *water of crystallization*. The same substance does not always contain the same number of molecules of water of crystallization. Sodium carbonate, for instance, usually contains ten molecules. At higher tempera-

tures it may be made to crystallize with eight or with but five molecules, and under some circumstances it contains but one molecule of water. This combination with water must be carefully distinguished from the mechanical retention of water in the interstices of crystals, which takes place particularly where the crystals are large and have been formed rapidly. Water retained in this way is termed *interstitial water*, or *water of decrepitation*, because it is the cause of the *decrepitation* of bodies when exposed to heat: the sudden expansion of the water causes the substance to crackle and burst into fragments. Crystals containing combined water lose part of it on exposure to the atmosphere, and the transparency noticed when the crystal was fresh is replaced by opacity and the formation of a dry powder on the surface. This change is termed *efflorescence*. There are very few substances which will part with all their water of crystallization at ordinary temperatures, nearly all requiring a high heat to effect the object. The act of driving off the water and reducing the crystals to the form of a dry powder is called *exsiccation*. Some substances absorb water from the atmosphere, and, instead of becoming dry, grow moist, and in some cases are converted entirely into liquids. Such substances are said to be *hygroscopic*, and the act is termed *deliquescence*. A good example is found in potassium carbonate which has been exposed to moist air.

Mother-liquor.—The liquid remaining after the crystals have formed is called *mother-liquor*, and still contains some of the salt in solution. This liquid retains as much of the solid as the solubility of the latter and the temperature will permit. It may be evaporated, and another crop of crystals obtained, if desired. Where two salts are in solution, it is obvious that the more soluble salt must exist in largest proportion in the mother-liquor: hence salts are frequently separated from each other by taking advantage of their difference in solubility: thus cinchonine is separated from quinine. The process is termed *fractional crystallization*.

Crystallizing Vessels should be deep, and made of rough-glazed stone-ware or porcelain. On the large scale, wooden tanks or vats are employed. In the crystallization of alum the staves of the vats are retained in place by iron hoops, which may be tightened or loosened by screw-bolts. After the solid crust of alum is formed around the sides and bottom, the hoops are loosened, the staves removed, and a hole chiselled through the side crust near the bottom, to permit the mother-water to escape.

Collection, Draining, Washing, and Drying of Crystals.—Upon the small scale it is usually sufficient, after the mother-water is decanted, to break the crust of crystals, and, having placed a few pieces of clean broken glass in the throat of the funnel, to place the crystals upon them and drain thoroughly. They are then to be washed by pouring water carefully and sparingly upon them. If the crystals are very soluble in water, and it is necessary to free them entirely from mother-liquor, they must either be washed with alcohol or some liquid in which they are not so soluble, or with ice-cold water, used very carefully but quickly by pouring it drop by drop upon the crystals, so that the smallest quantity will suffice. After draining, they may be transferred to a double

sheet of filtering-paper, placed on a bed of two or three newspapers or cloths, loosely covered, and removed to a dry atmosphere. If the crystals are liable to effloresce, they should be turned several times, and bottled as soon as fairly dry. Deliquescent crystals, like those of chromic acid, may be dried by spreading them on a clean brick in a dry room. The mother-water will be gradually absorbed by the brick, and as soon as the crystals are dry they are transferred to a close vessel.

Intermediate Crystallization is a term used to define the process of crystallizing a substance which is comparatively insoluble in simple solvents, by causing it to dissolve in a hot solution of another substance. Of course the latter should be very soluble: the whole of the ordinarily insoluble salt will entirely crystallize out at the first attempt. Mercuric iodide may be made to crystallize in this way in brilliant scarlet crystals by dissolving it in a hot solution of sodium chloride, potassium iodide, or mercuric nitrate.

CHAPTER XVI.

GRANULATION AND EXSICCATION.

By granulation is meant the process of heating the solution of a chemical substance, with constant stirring, until the moisture has evaporated, and a sabulous, coarse-grained powder is produced. It is a convenient method of obtaining many substances in the form of powder: indeed, the practical advantages of granulated powders are so well recognized now at the prescription-counter, that their use in preference to large crystals is rapidly extending. This is particularly the case with salts which are not very soluble in water, or which are commonly found in commerce in hard, tough, crystalline lumps or masses. The process of granulation is one which requires care, but no great amount of skill. The solution of the substance is generally evaporated rapidly until a pellicle forms upon the surface. Then the heat is moderated, in order to prevent spurting and caking: great care must be exercised at this stage of the process to stir the mass constantly, as the tendency to form a crust on the bottom is very great, and when this hard crust is broken up by the stirrer it is very difficult to avoid the formation of lumps; but if the crust is not allowed to form, by keeping the bottom of the dish clean through constant stirring, the salt will separate in distinct grains, which will not adhere to each other. Towards the end of the process the heat should be very moderate, and the product should be introduced at once into a clean, warm, dry bottle.

Granulated Effervescent Salts are made by mixing the dry powders with dry tartaric acid and sodium bicarbonate and moistening the mixture with strong alcohol. The pasty mass is passed through a sieve, and the granules dried quickly in a hot room, sifted, and filled into bottles, which must be hermetically sealed to prevent the access of moist air.

Exsiccation is the process of depriving a solid crystalline substance of its water of crystallization or moisture by heating it strongly.

The product is usually a fine powder, and the original crystalline condition of the substance may be restored by redissolving it and evaporating the solution. The process is conducted by exposing the crystals to the air or a warm temperature until they are effloresced, and then gradually heating, with stirring, until they cease to lose weight; the residue is then powdered and kept in well-stopped bottles. The object of exsiccation is to increase the strength of substances and thereby fit them for special applications. For instance, exsiccated sulphate of iron is preferred as an ingredient in pills, because sixty grains contain as much ferrous sulphate as one hundred grains of crystallized sulphate of iron, and the pills can therefore be made one-third smaller. The mass is also much more readily formed from the finely-powdered exsiccated salt.

CHAPTER XVII.

DIALYSIS.

DIALYSIS is the process of separating crystallizable substances from those which do not crystallize, by suspending a mixture of both upon a porous diaphragm which has its under surface in contact with water. This remarkable process was discovered by Graham in 1861. He termed the substances which had the power of passing through the septum or diaphragm *crystalloids*, because they always have the crystalline form, and those which remained upon the diaphragm *colloids*, from their resemblance to gelatin and because they never crystallize. He also pointed out the differences between the two classes. Crystalline bodies, or crystalloids, are diffusible, brittle, hard, with clearly-defined angles and flat faces: their solutions are free from viscosity, and their reactions energetic and quickly effected. (Example, sugar.) Colloidal bodies, on the other hand, are not diffusible: they are tough, with more or less softness of texture. The mathematically-arranged angles and faces of crystals are replaced in colloids by rounded, irregular outlines, the fracture often being curved or conchoidal. Water of crystallization is replaced by water of gelatination, and the solution of colloids is, when concentrated, viscous or gummy, and their reactions are sluggish or inert. (Examples, gum, glue, starch, dextrin, gelatin, albumen, extractive matter.)

A thin layer of gelatin interposed between two liquids offers no obstacle to the passage of the crystalloids from one to the other, while it completely prevents the passage of the colloids: this property belongs not only to gelatin, but to other substances having a similar molecular constitution, as bladder, parchment, etc., of which the most convenient is the texture known as *parchment-paper*, prepared by immersing unsized paper in a *cold* mixture of two measures of sulphuric acid and one of water, and subsequently washing it thoroughly to free it from acid.

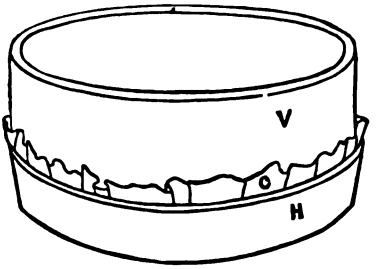
Upon the principles stated above Prof. Graham contrived a very simple apparatus which he called the dialyzer (see Fig. 284). It consists of two parts, one a circular glass recipient (*b*), about a foot in diameter and six inches deep, the other (*a*) a similar circular vessel, from six to ten inches in diameter and about two inches deep, the circumference of which consists of a band of gutta-percha and the bottom of a circular piece of parchment-paper, the edges of which are brought over the lower rim of the gutta-percha band nearly to the top, and fastened outside of it by a string or by a narrow hoop of gutta-percha. The first part, or circular basin, is to receive distilled water, and should contain from five to ten times the quantity of the liquid that may be introduced into the smaller vessel. The latter is to float upon the surface of the water in the former, and is to receive the liquid to be submitted to dialysis, which should not

be more than half an inch deep on the paper bottom. It is important that the parchment-paper employed should have no rent or aperture, and should be brought well up and secured on the outside of the gutta-percha to prevent the liquid from passing between them. If any liquid containing a mixture of colloid and crystalloid matter be placed in the floating vessel, after some hours it will be found that a portion of the latter has passed through the parchment-paper, and is held in solution

FIG. 284.

Dialyzer.

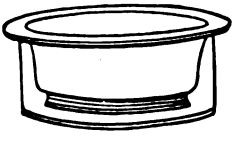
FIG. 285.



Dialyzer.

by the distilled water of the larger vessel, while the colloid matter remains. The distilled water thus impregnated is called the *diffusate*. The parchment-paper, or any similar material used as the septum, is applicable to the dialysis of substances held in watery solution only, and will not answer for alcoholic or ethereal liquids. The hard-rubber sieve, which has been already noticed (see Fig. 285), makes an excellent dialyzer if floated upon pure water in an evaporating dish or beaker. Fig. 286 shows another form, in which the glass dialyzer has its upper edge expanded into a flat shoulder, which rests upon the upper edge of the round dish[1] containing the water. This has the advantage of keeping the diffusate covered whilst the dialysis is progressing. It is obvious that very different arrangements might be made to accomplish the same ends. Thus, a bladder three-fourths filled with a mixture, suspended in a jar of distilled water, would yield similar results. Graham's apparatus is preferable to others only for its convenience.

FIG. 286.



Dialyzer.

The following applications of the process of dialysis have been made: 1. It facilitates in many instances to a considerable extent the separation of the active matter of any artificial or natural mixture from the inert and useless, the former being very often crystalline and the latter colloidal. Thus, infusions or decoctions of medicines, such as opium, belladonna, aconite, etc., submitted to dialysis might give up more or less completely their crystalline principles, such as the salts of morphine, atropine, aconitine, etc., to the water, while the gummy, resinoid, extractive, and coloring matters, etc., might remain behind. In effecting

[1] This vessel is sometimes called the "exarysator."

the analysis of organic bodies, one of the most embarrassing problems is to get rid of the inert principles which interfere with the action of chemical reagents, and the process of dialysis may here often be brought to the aid of the operator. 2. In searching for poisons in organic mixtures, as in the contents of the stomach, in which the application of tests is often rendered abortive by the colloidal matter present, the problem of the presence of the poison may sometimes be solved by submitting the suspected matter to dialysis. The poison will often be found in the diffusate separated from the other matters, and may then be detected by the ordinary tests. 3. In pharmaceutical operations it often happens that salts and other crystallizable substances are thrown away as refuse matter because they would not repay the cost of time and material necessary for their recovery. It is possible that by this simple, inexpensive process these substances may be separated from the useless matters and thus saved. 4. An economical application has been made of the process to the restoration of salted meat to the fresh state. If some salt beef with its brine be enclosed in a bag of material suitable for dialysis, as of untanned leather, and the bag be immersed in sea-water, in the course of some days the beef and brine will have been rendered sufficiently fresh for use, the salt having passed out into the sea-water. B. F. McIntyre, of New York, has given a great deal of attention to the practical applications of dialysis, and has introduced a class of preparations called *Dialysates*. These are prepared from various drugs by dialysis, and it is claimed that they contain the active crystallizable constituents in their original combination, deprived of inert colloidal substances.

Dialyzed iron, or *Ferrum Dialysatum*, is a colloidal preparation made by placing a mixture of basic ferric chloride and ammonium chloride upon a septum: the crystalloids (ammonium chloride and ferric chloride), with any free acid, pass into the diffusate, leaving the neutral colloidal liquids upon the septum.

CHAPTER XVIII.

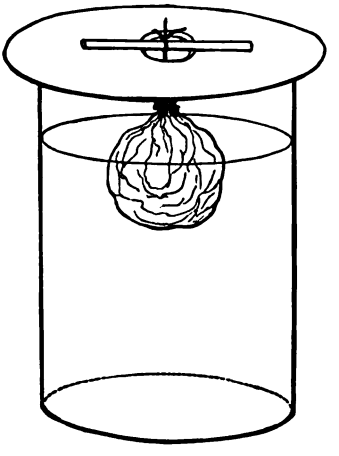
EXTRACTION.

UNDER this head are included those operations which have for their object the separation of the soluble principles from drugs by treating them with a liquid capable of dissolving them, which is called the *menstruum*. Extraction differs from solution in the fact that the presence of insoluble matter is implied in the former, and the soluble constituents must therefore be *extracted* or separated, by appropriate methods, from those which are insoluble. The principal modes of extraction employed in pharmacy at present are as follows: 1. Maceration and expression. 2. Percolation. 3. Digestion. 4. Infusion. 5. Decoction. Maceration and expression are old processes, and they will be considered first; percolation is much more important and useful, and will be treated of in a separate chapter; digestion is merely a modified form of maceration. Infusion and decoction are processes which are used in producing separate classes of officinal preparations: hence they will be considered in Part II.

MACERATION.

The process of *maceration*, which is of ancient origin, consists simply in soaking the properly comminuted drug or substance in the menstruum until it is thoroughly penetrated and the soluble portions softened and dissolved. The usual method is to introduce the drug or substance into a bottle with the menstruum, cork it tightly, and agitate it occasionally for a period ranging from two to fourteen days; then to pour off the liquid, express the residue to avoid waste, and filter the mixed liquids. An advantage is sometimes gained by suspending the ground drug, tied in a bag, in the upper part of the menstruum (see Fig. 287): this is sometimes termed *circulatory displacement*. Maceration is the process directed by the German Pharmacopœia exclusively in preparing tinctures: the drugs are ordered in all cases to be macerated in definite weights of alcohol for a week in a closed bottle, in a shady place, with frequent agitation, at a temperature of about 15° C. The liquid is then separated by strain-

FIG. 287.



Circulatory displacement.

ing or expressing from the insoluble residue, and, after having been allowed to settle, it is filtered. Evaporation during filtration is to be avoided as much as possible. Maceration has no advantages over percolation in making the greater number of liquid preparations from drugs, except in the hands of the careless or unskilful. If an operator possesses no knowledge whatever of the process of percolation, it is safer to trust to maceration, for here no particular skill or judgment is necessary; the soaking process is completed in due time, and the separation of the absorbed liquid, whilst laborious and uncleanly, has at least the merit of leaving the tincture uniform in strength; if the process of expression is not thoroughly performed, pecuniary loss results, but the finished preparation is uniform. On the other hand, in percolation, if the operator has, through careless packing, failed to exhaust thoroughly the drug with the amount of menstruum used, a portion of the activity of the drug remains in the residue, which is thrown out, and the preparation is thus deficient in strength. In making tinctures by maceration, the practice of weighing liquids, as directed in the German Pharmacopœias, is seen to the best advantage, although, of course, the principal objection to preparations made from weighed liquids still exists,—the necessity for a calculation to determine the dose as compared with that of the drug. The tincture must always be administered by measure, and hence a teaspoonful or a fluidrachm should bear a certain relation to the drug, which is readily ascertained without resorting to a problem in specific gravity.

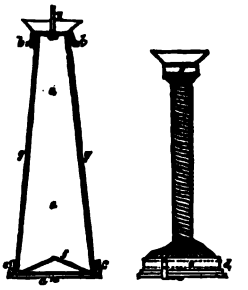
CHAPTER XIX.

EXPRESSION.

EXPRESSION is the process of *forcibly* separating liquids from solids. It is generally effected by the use of a press, although for many pharmaceutical operations, upon the small scale, the use of straining-cloths with hand-pressure suffices. Pressing-cloths are generally employed, but they are troublesome, and of late years strong efforts have been made to construct presses which could be used without them. At least six mechanical principles are recognized in the operation of expression as now practised: namely, by the use of—1. The spiral twist press. 2. The screw press. 3. The roller press. 4. The wedge press. 5. The lever press. 6. The hydraulic press.

1. **The Spiral Twist Press.**—The principle of this press is best and most practically illustrated in the usual process of expressing a substance contained in a cloth with the hands. The mixture to be expressed is placed in a bag or a cloth held in one hand by the four corners, which are gathered together, and the lower portion, or bag, is rotated with the other hand, so that, beginning at the top, the point of smallest diameter, the strainer is spirally twisted, the pressure forcing the liquid between the meshes of the cloth. Fig. 288 shows Gigot's press, in which this principle is used upon a larger scale. On the left hand is shown a sectional view of the press as it appears when filled with material. The perforated cone, *d*, forms the bottom of a conical strong cloth tube; the upper end is connected with a funnel, *l*, which is so constructed that none of the material that has passed down into the bag can leak back. The lower portion of the cloth is secured to a ring, which may be fastened, so that it will not rotate when the press is used. If the upper end of the cloth is twisted, the space occupied by the material is contracted, and the liquid oozes through the meshes of the cloth. The dry residue is discharged by untwisting the cloth and unhinging the bottom, which opens downwards.

FIG. 288.



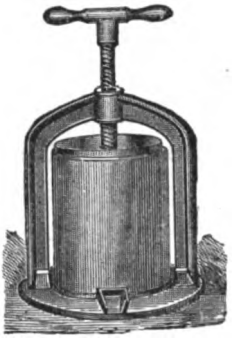
Gigot's press.

2. **The Screw Press** is the most useful of all forms for pharmaceutical work where very great power is not desired. The screw is always used in combination with one or more levers, and this form of press is employed in great variety to accomplish special purposes. There are two forms of screw presses: 1. Single-screw presses. 2. Double-screw presses. Each of these forms may be subdivided into

those in which the position of the screw or screws is *vertical*, and those in which the position of the screw or screws is *horizontal*.

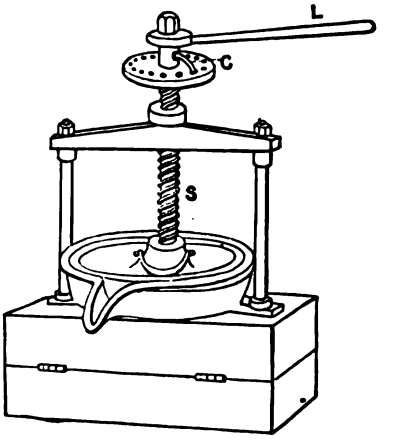
1. *Single-Screw Presses.*—In this form of press the single screw is generally used in a vertical position, and operated with a lever or a combination of levers. It is the simplest kind of press, and if well made will admirably answer the general purposes of the pharmacist. The screw should have a square-faced thread, and be well made. The plunger should be disconnected from the end of the screw, or else move freely around it. The parts of the press which come in direct contact with the material to be pressed should be coated with tin or porcelain, so that liquids containing acid or tannin shall not be affected injuriously. Fig. 289 shows a press of this description, made by H. Troemner, of Philadelphia. A perforated tin case accompanies the press. This may be used when pressing bulky drugs, like arnica flowers, and press-cloths may be abandoned. The best material for press-cloths

FIG. 289.



Troemner's press.

FIG. 290.

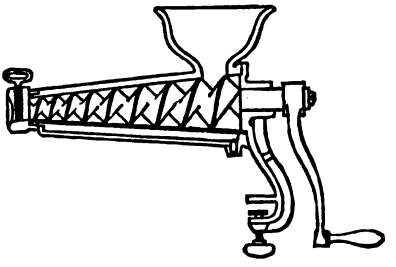


German single-screw press.

is that which is especially made for the purpose. It is twilled and elastic in one direction, and, if proper care be taken when enveloping the material and introducing it into the press, the same cloth may be used many times, as the pressure causes the meshes to open without breaking the threads. The manufacturers of linseed oil use press-cloth largely. For small operations, in the absence of press-cloth, which is very expensive, new Russia crash may be used. The press-cloth should be moistened, if possible, with some of the same liquid expressed at a previous operation. Water answers very well if the liquid is aqueous. The substance to be pressed is laid upon the cloth, and one corner of the cloth laid over it. The opposite corner is then placed upon the first; next one of the remaining corners is laid in the same way upon the first two, followed by its opposite. The corners should be folded over so that a square, somewhat flat package is produced, in size somewhat smaller than the press-plate, especial care being observed to suit the quantity of material to the capacity of the press. If too much is taken, the press-cloth will be too small to permit of folding it over sufficiently; the corners

of the package will therefore not withstand the pressure, portions of the material itself will ooze out, and the whole operation must be repeated. The principal objection to the single-screw press is, that unless the material in the press is nearly homogeneous, so that the press-cake is equally pressed upon at all points, unequal action results, the press-block is pressed against one side of the case, causing violent friction and and resistance, and the thread of the screw binds upon one side, full pressure thus being defeated; whilst the main objection to the vertical screw is, that the press-block and plate must be in a horizontal position, so that the liquid pressed out adheres to the cloth, and cannot be collected readily without tilting the press. Fig. 290 is an illustration of a German single-screw press which is well adapted for pressing the residues from macerated tinctures. The large lip of the containing vessel is a practical convenience, whilst the lever, L, in combination with the catch, C, gives unusual power and ease in working, for a small press. In the horizontal screw press, the jaws being vertical, there can be no obstruction to the dropping of the expressed liquid, which may be caught in a vessel placed immediately under it. Oberdoffer, of Hamburg, Germany, makes a very powerful horizontal screw and compound lever press. Fig. 291 illustrates a novel horizontal screw press, made by the Enterprise Manufacturing Company, of Philadelphia, which is operated without a press-cloth. It consists essentially of a tapering cylinder, with a hopper on the upper side at its large end, and a strong screw fitting closely to the inner surface of the case, the thread of which diminishes in size as the screw becomes smaller. Along the under side of the cylinder is formed a channel adapted to receive a perforated brass plate. This latter has a transverse concavity corresponding to that of the inner surface of the cylinder, and the perforations allow the escape of the expressed fluids into the channel or gutter beneath, from which it escapes by a proper outlet. The substance to be expressed is placed in the hopper, and, the crank attached to the screw being turned in the proper direction, the thread of the screw compresses the substance into a smaller and smaller space, until finally it is discharged at the farther end of the cylinder in a comparatively dry state. A large screw, passing through a removable end of the conical cylinder, regulates the size of the outlet, and serves to increase or diminish the amount of pressure to which the mass is subjected by the screw. The brass plate in the bottom of the machine can be replaced by others having perforations of different sizes. Clogging of the holes by bits of wood, stems, or seeds is prevented by the shear-like action of the edge of the screw-thread, which shaves off the protruding fragment, while the rest is forced through the perforation. To increase the power of the press upon slippery substances, the inside of the casing has a few longitudinal

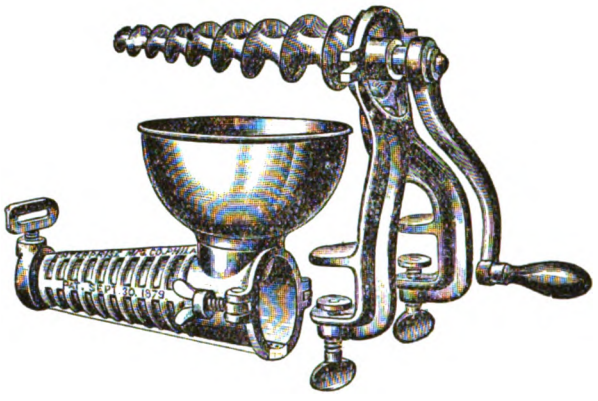
FIG. 291.



Enterprise press.

or spiral grooves at a greater or less angle to the direction of the screw-thread. Arrangements are provided for detaching the casing from the screw, and for attaching the whole to the edge of a table or bench. Fig. 292 shows the press as taken apart.

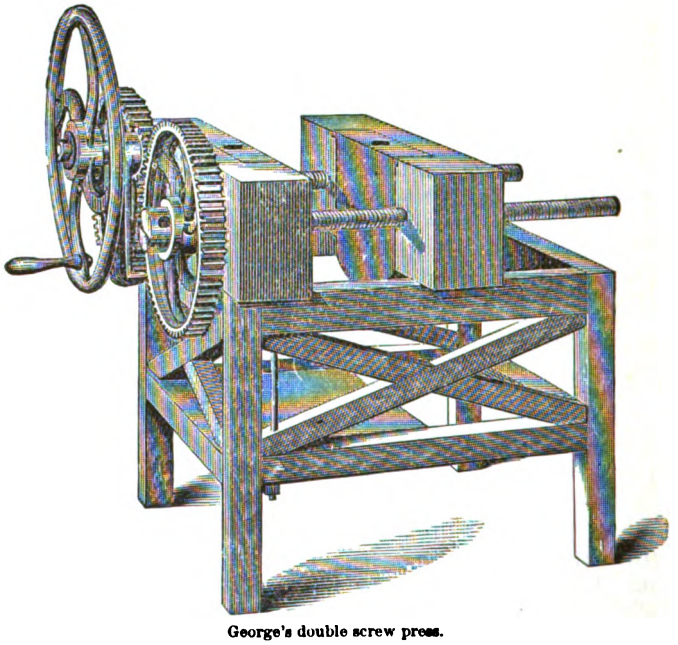
FIG. 292.



Enterprise press.

2. *Double-Screw Presses* are preferred by many. These are always of the horizontal screw form, and in Fig. 293 is shown one made as proposed by Chas. T. George, of Harrisburg, Pa. A strong and substantial framework, made of ash wood, forms the base. Two pieces of timber rest upon this frame, one firmly attached by an

FIG. 293.



George's double screw press.

iron rod and keepers to one end of the frame or table, and the other free or movable, both blocks being bored at the same distance from the end with smooth holes to receive the two iron screws.

Upon the movable block, and opposite the holes, a female nut of bell-metal is firmly fixed. Upon the inner face of the two timber blocks, iron castings, saddle-shaped and hollow, are inserted, flush with the face of the block, each capable of holding six pints of boiling water, and each casting having a hole on top to receive hot water or steam: a brass pet-cock is fixed at the bottom to discharge the chilled water.

The two iron screws pass through the holes of both blocks of timber, the head of each screw having an iron cog-wheel attached to it; into the cogs of each wheel a pinion-wheel is firmly fixed, which in turn is fastened to a short shaft having at its end an iron fly-wheel.

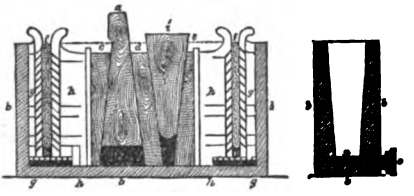
By turning this wheel both screws are evenly and rapidly rotated without danger of bending or breaking, and consequently one block is drawn surely and with great power against the other, thus expressing whatever drug may be placed in a sack of strong linen towelling between the two blocks of timber.

It is apparent that the double-screw press is very powerful, and, the pressure being equalized, good results are obtained.

3. *The Roller Press* is used upon the large scale for pressing oily seeds, fatty substances, etc. Its principle is thoroughly shown in the well-known clothes-wringer, which, although made for the laundry, serves as a very efficient press for many substances. Care must be taken to apply the force gradually to the bag containing the berries or other material to be pressed, and not to use it upon substances which will soften or dissolve the rubber rollers.

4. *The Wedge Press.*—This form of press is powerful, economical, and inexpensive. It is objectionable principally on account of the noise necessarily made in driving the wedges. Fig. 294, taken from Knapp's Technology, illustrates the wedge press. The filled cloths are laid between strong plates, *h* and *g*, and placed in a square space cut in a solid block of oak wood or in a cast-iron case, *b*, and the plates are forced nearer and nearer to each other by driving in the wooden wedges which occupy the remaining space. One of these wedges, *a*, serves to facilitate the disconnection of the apparatus; the strokes which drive in the wedge *i* tending, from the reverse position of *a*, to drive the latter out; *c*, *e*, and *d* are intermediate pieces to prevent the wedges from coming into immediate contact. The pressing-plates are each provided with three side ribs: the immovable ones, *g*, *g*, press against the sides of the case, and the movable ones, *h*, *h*, against the intermediate wedges, *c*, *e*, and are pierced with numerous holes to allow the liquid to flow out more easily. On filling the press, the wedge *a* must be suspended (by a string) at a distance from the bottom, so that the apparatus may be easily taken to pieces. The liquid trickles from the pressing-plates through the pierced horizontal plates, *n*, *n*, upon which these rest, into the pipe *o*. Both *a* and *i* are driven by separate stampers, which are raised by a toothed wheel, or mallets may be used.

FIG. 294.

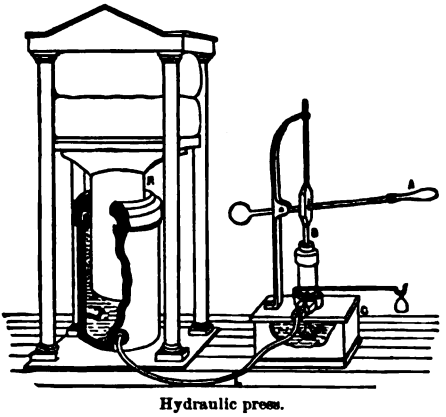


Wedge press.

5. *The Lever Press.*—The only advantages possessed by this press over those previously noticed are its cheapness, and that it may be made by any one possessed of even moderate mechanical abilities. Prof. Procter recommended the following method of construction. "A piece of timber twelve feet long, and with lateral dimensions sufficiently great to be inflexible with the force to be applied to it, has one of its ends securely attached to a wall or upright post in such a manner as to admit of the motion of the other end. The pressing-box being placed about one foot from the fixed end, on a firm block of wood, is subjected to the action of the lever by placing a piece of wood vertically between the piston-block of the pressing-box and the lever. It is obvious that a weight of one hundred pounds at the opposite end causes a downward pressure equal to eleven hundred pounds at the box. The pressing-box most usually employed is a cylinder, closed at one end, made of thick tinned-iron, secured with bands of the same material, which are soldered on, and between these, numerous holes are perforated. This cylinder is set in a tin dish with a lateral spout. The piston-block is constructed of hard oak wood with the grain running transversely to its axis." The objection to this press is that, compared with other presses, it yields but little power in proportion to the space occupied; but as an offset to this it can be made to work simply and quickly.

6. *The Hydrostatic or Hydraulic Press.*—Of the presses heretofore mentioned, each has some especial advantage or use, but each has also some fault or objectionable feature. The spiral twist is not powerful, and its action is limited. The screw presses of both varieties have friction to contend with. The friction of a screw increases with the intensity of the pressure applied, and when a certain limit is reached all further force applied is wasted, and, if persisted in, involves the destruction of the press. The roller press is very limited in its action; the lever press is unwieldy and not powerful; the wedge press is noisy and can be used only for special purposes. The hydrostatic press is costly, but after the first cost it is the most economical, because the greatest power is obtained at the expense of the least labor. The principle is shown in Fig. 295. It must be remembered that the molecules of fluids move freely in contact with one another almost without friction, and, according to Pascal's law, "Pressure exerted anywhere upon a mass of liquid is transmitted undiminished in all directions, and acts with the same force on all equal surfaces and in a direction at right angles to those surfaces."

FIG. 295.

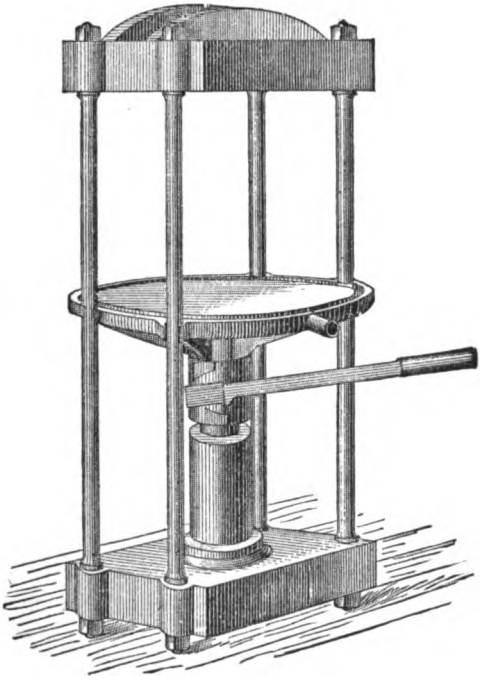


Hydraulic press.

Although it has been proved that liquids are to a slight extent compressible, it has also been shown that they are *perfectly elastic:* so that

if a plug be forced into a liquid which entirely fills a vessel, the pressure is felt equally upon every square inch of the surface of the vessel and upon every square inch of the surface of any body immersed in the liquid, and if the pressure is removed from the plug it will be immediately forced out of the vessel and the liquid will at once regain its original volume. Now, if a vessel is constructed having two columns communicating at the bottom, as in Fig. 295, and if water or other fluid is placed in it, it will be found that a pressure of one pound applied at the piston in the tube, B, will be communicated to every portion of the lower surface of the ram, R. If the area of R is ten times greater than that of B, it follows that a pressure of one hundred pounds on A, conveyed through the lever, exerts an upward pressure of one thousand pounds on R. By increasing the area of the ram the power may be greatly multiplied, so that pressure applied by one man on the lever may be communicated to the liquid and made to exert an upward pressure of several tons. Fig. 296 shows a pharmaceutical press made by R. Dudgeon, of New York, constructed on the principle of hydrostatic pressure. In order to economize space, by an ingenious system of valves one of the cylinders is contained within the other, and by pumping the oil into the outer vessel the ram carrying the platen is forced upward. The platen has a groove around its edge communicating with a spout for carrying off the expressed liquid. Press-cloths may be used to contain the material to be pressed, or a very strong perforated case is supplied. The upper plate is very strongly secured by bolts and nuts, and press-blocks covered with tinned iron are employed to fit into the perforated case if desired. The weight of one man, one hundred and fifty pounds, applied to the end of the lever will produce an upward pressure equivalent to ten tons. This is the most powerful press available for pharmaceutical purposes, and, although expensive, its first cost will be more than offset by its durability and by its economy of power whenever pressure greater than that afforded by the smaller presses is needed.

FIG. 296.



Dudgeon's press.

The following maxims should be observed in operating presses:

1. All moving parts of the press should be well lubricated before attempting expression.

2. Pressure should be *gradually* increased; sudden strains should always be avoided. If this precaution is neglected, either the press-cloth or press-bag will burst, the finer solid particles will be forced through the meshes, or breakage of press-plates or press will result.

3. Pressure, to secure the best results, should be unrelaxed, but intermittent. After apparently reaching the limit of compression, the action of the press should cease, and if the pressure be maintained unrelaxed it will be found that in a short time further pressure may be applied and more liquid separated. In this way, by alternately exerting pressure and resting, the utmost limit of the power of the press may be gradually reached without undue strain. Screw presses have more ability to retain pressure than hydraulic presses: the valves of the latter frequently leak slightly, and the pressure has to be continually renewed.

CHAPTER XX.

PERCOLATION.

Percolation, or Displacement, is the process whereby a powder contained in a suitable vessel is deprived of its soluble constituents by the descent of a solvent through it. The importance of this process cannot be overestimated, as the progress made in pharmacy in America during the last half-century is largely due to the study and development of percolation, and the introduction of preparations which are the direct outgrowth of the process.

History.—The practice of exhausting wood-ashes of their soluble constituents by pouring water upon them after their introduction into a conical-shaped wooden vessel called a lye-hopper is an ancient one, and the process is still practised and known as *lixiviation.* The first attempt on record to apply the principle to powdered drugs was made by Count Real, who about the year 1815 invented a press which consisted of a metallic cylinder with a stop-cock in the bottom and containing a perforated diaphragm for supporting the substance, and with a tight cover at the top, to which was attached an upright tube, ten or twelve feet high, having a funnel soldered to its upper extremity: the cylinder was packed with the coarsely-ground drug, and water poured into the tube. The pressure of the column of water was so great, however, that the principal difficulty in using the apparatus was in securing tight joints, and in preventing the incomplete exhaustion of the drug on account of the too rapid passage of the water through it. M. Robiquet subsequently made some experiments to determine the power of ether as a solvent in extracting the fixed oil from the bitter almond: he observed that ether poured on powdered bitter almond displaced the fixed oil without mixing materially with it, and he published his observation. It was reserved, however, for the Boullay brothers, of Paris, in 1833, to apply the ideas of Real and Robiquet to drugs and medicinal substances in general, and to them belongs the credit of first demonstrating the value of the process of percolation in its pharmaceutical applications. The researches of the Boullays at once attracted the attention of American pharmacists, and the labors of Duhamel, Procter, Grahame, Squibb, and others during the last half-century, and the adoption of the process in the Pharmacopœias of 1840, 1850, 1860, 1870, and 1880, sufficiently show the character of the growth in favor of percolation. In Great Britain, France, and Germany the process is well known and is practised to some extent, but maceration still holds in these countries the chief place as a means of extracting the soluble principles of drugs.

Principle of Action.— *When a powder placed in a cylindrical vessel with a porous diaphragm below, is treated from above with a liquid capable of dissolving a portion of its substance, that portion of the fluid first in contact, in passing downward, exercises its solvent power on the successive layers of the powder until saturated, and is impelled downward by the combined force of its own gravity and that of the column of liquid above it, minus the capillary force with which the powder tends to retain it.* If the quantity of liquid added is not more than enough to satisfy the capillarity of the powder, no liquid will pass the diaphragm; but the careful addition of liquid upon the top displaces that absorbed in the powder without mixing materially with it, and takes its place, to be in turn displaced by a fresh portion of liquid. The instrument used to hold the powder is called a *percolator;* the liquid poured on top of the powder, the *menstruum;* the liquid coming from the percolator impregnated with the soluble principles, the *percolate.* In order thoroughly to understand the process of percolation as applied to powdered drugs, it must be remembered that the soluble principles of vegetable substances are in a hard and dry condition, and are generally contained in cells which are more or less disintegrated by the process of grinding: if the soluble principles could be perfectly separated from the insoluble cellular substance by any means, and be deposited in the interstices of the ground particles, percolation would indeed be a rapid process, for the descending column of liquid would immediately dissolve the soluble principles, which would be found in the receiving vessel, while the insoluble substances would remain in the percolator, and the separation would then be easily accomplished. But the powdering of the drug very partially separates the soluble principles from the insoluble, and the finest dust of the powder always contains a larger proportion of the soluble principles than of the insoluble substance, because the latter, often being largely ligneous, offers the greatest amount of resistance to disintegration: hence the first portion of the percolate is always the most dense, the most highly colored, and contains the largest proportion of the soluble principles, because the first portion of menstruum, in its descent through the powder, has the first opportunity to come in contact with the largest proportion of the soluble principles, which are to be found in the finer dust scattered through the powder, and in the thoroughly disintegrated particles, which offer but slight resistance to the passage of the menstruum. In every well-conducted experiment in percolation it will be noticed that, as the operation proceeds, each succeeding portion of percolate is less highly colored and less active than the one preceding it; and in the case of drugs containing easily-dissolved coloring-matter, an examination of the percolate will show that the shading is very marked, the lowest portion being very dense and dark-colored, the upper portion almost colorless, whilst in the intermediate liquid the gradations of the tint are clearly perceptible.

The directions of the United States Pharmacopœia upon percolation are as follows:

The process of percolation, or displacement, directed in this Pharmacopœia, consists in subjecting a substance or substances, in powder, contained in a vessel called a percolator, to the solvent action of succes-

sive portions of menstruum in such a manner that the liquid, as it traverses the powder in its descent to the recipient, shall be charged with the soluble portion of it, and pass from the percolator free from insoluble matter.

When the process is successfully conducted, the first portion of the liquid, or percolate, passing through the percolator will be nearly saturated with the soluble constituents of the substance treated; and if the quantity of menstruum be sufficient for its exhaustion, the last portion of the percolate will be destitute of color, odor, and taste, other than that possessed by the menstruum itself.

The percolator most suitable for the quantities contemplated by this Pharmacopœia should be nearly cylindrical, or slightly conical, with a funnel-shaped termination at the smaller end. The neck of this funnel-end should be rather short, and should gradually and regularly become narrower toward the orifice, so that a perforated cork, bearing a short glass tube, may be tightly wedged into it from within until the end of the cork is flush with its outer edge. The glass tube, which must not protrude above the inner surface of the cork, should extend from one and one-eighth to one and one-half inch (3 to 4 centimeters) beyond the outer surface of the cork, and should be provided with a closely fitting rubber tube, at least one-fourth longer than the percolator itself, and ending in another short glass tube, whereby the rubber tube may be so suspended that its orifice shall be above the surface of the menstruum in the percolator, a rubber band holding it in position.

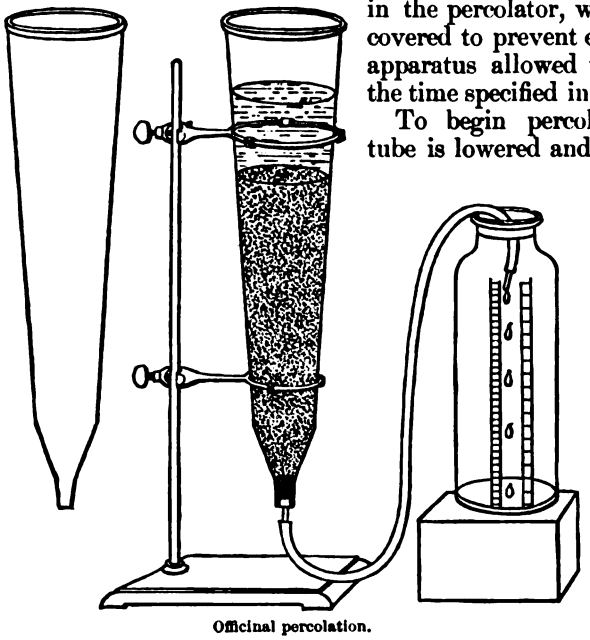
The dimensions of such a percolator, conveniently holding five hundred grammes of powdered material, are preferably the following: Length of body, fourteen inches (36 centimeters); length of neck, two inches (5 centimeters); internal diameter at top, four inches (10 centimeters); internal diameter at beginning of funnel-shaped end, two and one-half inches (6.5 centimeters); internal diameter of the neck, one-half inch (12 millimeters); gradually reduced at the end to two-fifths of an inch (10 millimeters). It is best constructed of glass, but, unless so directed, may be constructed of a different material.

The percolator is prepared for percolation by gently pressing a small tuft of cotton into the space of the neck above the cork, and a small layer of clean and dry sand is then poured upon the surface of the cotton to hold it in place.

The powdered substance to be percolated (which must be uniformly of the fineness directed in the formula, and should be perfectly air-dry before it is weighed) is put into a basin, the specified quantity of menstruum is poured on, and it is thoroughly stirred with a spatula, or other suitable instrument, until it appears uniformly moistened. The moist powder is then passed through a coarse sieve—No. 40 powders, and those which are finer, requiring a No. 20 sieve, whilst No. 30 powders require a No. 15 sieve for this purpose. Powders of a less degree of fineness usually do not require this additional treatment after the moistening. The moist powder is now transferred to a sheet of thick paper, and the whole quantity poured from it into the percolator. It is then shaken down lightly and allowed to remain in that condition for a period varying from fifteen minutes to several hours, unless otherwise directed;

after which the powder is pressed, by the aid of a plunger of suitable dimensions, more or less firmly, in proportion to the character of the powdered substance and the alcoholic strength of the menstruum; strongly alcoholic menstrua, as a rule, permitting firmer packing of the powder than the weaker. The percolator is now placed in position for percolation, and, the rubber tube having been fastened at a suitable height, the surface of the powder is covered by an accurately fitting disk of filtering-paper, or other suitable material, and a sufficient quantity of the menstruum poured on through a funnel reaching nearly to the surface of the paper. If these conditions are accurately observed, the menstruum will penetrate the powder equally until it has passed into the rubber tube and has reached, in this, the height corresponding to its level in the percolator, which is now closely covered to prevent evaporation, and the apparatus allowed to stand at rest for the time specified in the formula.

FIG. 297.



Officinal percolation.

To begin percolation, the rubber tube is lowered and its glass end introduced into the neck of a bottle previously marked for the quantity of liquid to be percolated, if the percolate is to be measured, or of a tared bottle, if the percolate is to be weighed; and by raising or lowering this recipient, the rapidity of percolation may be increased or lessened as may be desirable, observing, however, that the rate of percolation, unless the quantity of material taken in operation is largely in excess of the pharmacopœial quantities, shall not exceed the limit of ten to thirty drops in a minute. A layer of menstruum must constantly be maintained above the powder, so as to prevent the access of air to its interstices, until all has been added, or the requisite quantity of percolate has been obtained. This is conveniently accomplished, if the space above the powder will admit of it, by inverting a bottle containing the entire quantity of menstruum over the percolator in such a manner that its mouth may dip beneath the surface of the liquid, the bottle being of such shape that its shoulder will serve as a cover for the percolator.

Fig. 297 illustrates an officinal percolation, the shape of the percolator and the arrangement of the exit-tubes being strictly according to the directions.

Shape of the Percolator.—It will be observed that the shape and size of the cylindrical percolator preferred for pharmacopœial operations are definitely fixed (see Fig. 297). There can be no question that the glass cylindrical percolators (see Fig. 298) commonly furnished by the manufacturers are proportionally too broad for use in percolating drugs for fluid extracts where the quantity of drug is large in proportion to the quantity of menstruum; but for ordinary tinctures, where the conditions are reversed, they answer admirably. The inference then is obvious, the pharmacist should have percolators not only of different sizes, but also of different shapes. Fig. 299 shows the narrow percolator recommended by Prof. Oldberg. It is narrower than the cylindrical percolator directed by the Pharmacopœia. The studies on percolation during the last half-century have been directed towards simplifying the process, and the elaborate apparatus of Count Real and others has been replaced by the ordinary percolator and funnel. The conical percolator of the Pharmacopœia is understood to be a glass funnel (see Fig. 300).

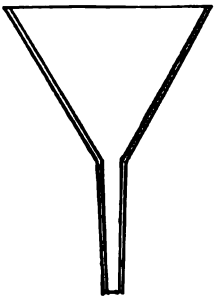
FIG. 298.

Plain percolator.

FIG. 299.

Oldberg's percolator.

FIG. 300.



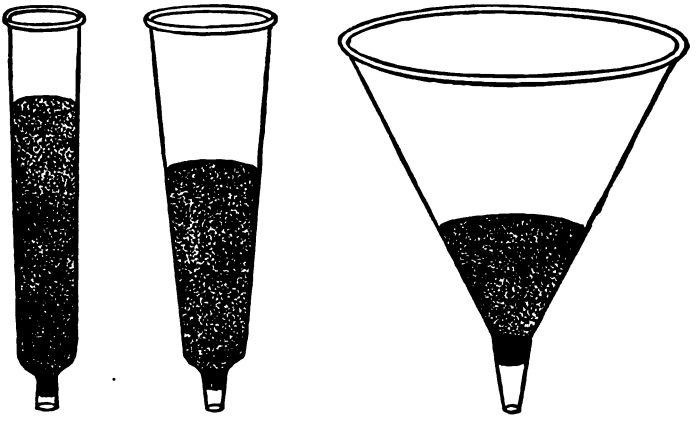
Conical percolator.

Judgment is required in selecting a percolator for an operation. In making a fluid extract a comparatively narrow percolator should be chosen, because it is desirable that the menstruum should traverse a higher column of powder, for every drop of the menstruum must be economically applied. The rate of flow of the percolator is thereby proportionally diminished, the percolate becomes saturated more rapidly, and thus the operation is more easily controlled, provided the limit has not been exceeded. *The character of the drug influences the limit.* For instance, one which contains a large quantity of soluble matter, like kino, could not be successfully percolated in a narrow percolator, because the percolate would soon become so dense that it would cease to descend. In making tinctures and weaker preparations, a wider percolator is to be preferred, because the quantity of menstruum is greatly in excess of the quantity necessary to exhaust the drug, and more rapid action is desirable. Figs. 301, 302, and 303 show three percolators of the same height, but of very different shapes. Exactly the same weight of powder is represented in each. The great difference in the height of the columns of powder will be readily noticed, and illustrates the necessity for judgment in selecting percolators. If a fluid extract from the drug is to be made, the tall percolator, Fig. 301, should be chosen; if a strong tincture, Fig. 302 indicates the shape; whilst for a weak tincture, the funnel shown in Fig. 303 would be preferred; it being

understood that in each case the drug chosen is not an exceptionally difficult one to percolate.

The Degree of Comminution proper for each Substance must depend upon the physical structure of the drug, the ease with which the menstruum dissolves the active or desirable constituents, the length

FIG. 301. FIG. 302. FIG. 303.



Narrow percolator, 16 oz. powder. Ordinary percolator, 16 oz. powder. Conical percolator, 16 oz. powder.

of time required to exhaust the powder, and the relative proportion of menstruum to drug. Nux vomica and ignatia are drugs having a tough, horny structure, in which the soluble constituents are embedded. If these drugs are to be quickly exhausted of their soluble principles, they must be in fine powder. On the other hand, gentian and rhubarb are drugs which part easily with their active constituents, because their structure is loose and quickly penetrated by the menstruum: therefore these may be readily exhausted when in coarse powder. The relative proportion of menstruum to drug also has a bearing in determining the fineness of the powder, for it is clear that if a fluid extract is to be made in which one hundred volumes shall represent *one hundred* parts by weight of the drug, the powder should be a finer one than would be required for a tincture where one hundred volumes are used to exhaust *ten* parts by weight of the drug. In all cases, whether coarse or fine powder is directed, the powder should be *uniformly divided;* and where the degree of fineness is specified, but a small proportion of the powder should be capable of passing through a sieve of the next higher grade of fineness, and this small proportion should be thoroughly distributed through the powder. The object of this is to permit the uniform descent of the liquid, for fine particles offer more resistance to the passage of the menstruum than coarse ones; and if the powder is not uniform, and the finer particles are deposited upon one side of the percolator, imperfect exhaustion may occur, through the passage of the greater portion of the menstruum upon the side of least resistance,—*i.e.*, through the coarser particles. After the powdered drug is moistened, it should be passed through a riddle or coarse sieve several times,

to render it uniform. The little sifter shown in Fig. 204 has been found very efficient for this purpose.

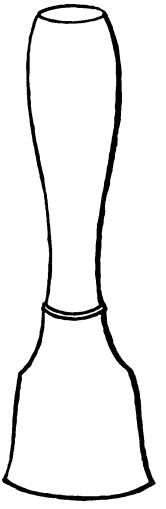
Moistening of the Powder.—The general rule in percolation is to moisten the powder, and there are very few instances in the officinal processes where it is not directed. The object of moistening the powder is very apparent. If a perfectly dry sponge is held in the hand and a gentle stream of water poured upon it, it will be noticed that very little water is absorbed by it; but if the sponge is thoroughly soaked, and all the water squeezed out that possibly can be, it will be found that it will greedily absorb water. Most drugs are vegetable substances which in their natural state were moist. The process of desiccation has hardened and dried the tissues, so that, like the sponge, they do not absorb moisture quickly, and when compressed, as they are when packed in a percolator, the resistance is still greater. If a dry powder, like ground orange-peel, is tightly packed in a glass percolator and water poured upon it, it will be noticed that the water will penetrate the powder but a short distance. Its further passage is prevented by the particles which are immediately in contact with the water, which have become swollen to such a degree that they press tightly against the sides of the percolator, and thus entirely overcome the gravitating force and penetrating power of the water. If, on the other hand, the powdered orange-peel is moistened *with sufficient water to satisfy its tendency to swell, before it is packed* in the percolator, the addition of water is followed by its slow percolation through the mass without stoppage, and the utility of moistening the powder is thus proved.

The special cases in which the powder should not be moistened are those in which the addition of menstruum would produce adhesiveness and cause the powder to form lumps that could not be easily penetrated, those in which the moistened powder would offer too little resistance to the passage of the menstruum, and those in which the menstruum is too volatile or too inflammable to render moistening desirable or safe. An instance of the first case is found in the so-called cold percolation of sugar in making syrups; instances of the second and third cases, in the preparation of the oleoresins where ether is used as the menstruum.

Packing the Powder.—The officinal directions with regard to this important part of the process of percolation vary continually. Where the degree of pressure is immaterial, no special directions are given. Where there is a likelihood of too much pressure being exerted, so that percolation would cease before it should, the directions are, "pack it moderately;" on the other hand, if there is danger of the operator allowing the menstruum to pass through too rapidly, so that the drug would not be exhausted of its activity, the directions are, "pack it firmly." The proper degree of pressure can be judged only from the character of the drug and the nature of the menstruum. If a porous, spongy drug is to be percolated with a menstruum largely aqueous, it must be moderately packed; but if the menstruum is alcoholic, it must be firmly packed. Before beginning to pack the powder, the throat of the funnel or of the percolator must be obstructed by a loose plug of absorbent cotton or a deeply-notched cork (see Fig. 304), or by some

other method. The manner of inserting this obstruction is not very material. The cotton, however, should be dry and loosely inserted, and the cork either dry or moistened with the menstruum, care being taken not to moisten the cotton or cork with water unless the menstruum is aqueous, because if the drug to be percolated is resinous, the first portions of percolate which come through will be precipitated by the water in the cotton or on the cork. Instances have occurred where the percolation has been stopped from this cause. The direction of the Pharmacopœia to pour a small layer of sand upon the top of the cotton, to keep it in place, is, in our opinion, unnecessary. Where the notched cork is used, it is well to place over the top of the cork, when it is in place, a small circle of scored filtering-paper (see Fig. 305). This is slightly larger in diameter than the cork, and the edges are therefore reflected up the sides. A small quantity of the moistened powder will keep the cotton or the filtering-paper and cork in place just as well as the sand.

Fig. 306.

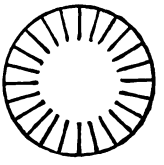


Packer.

Fig. 304.

Notched cork.

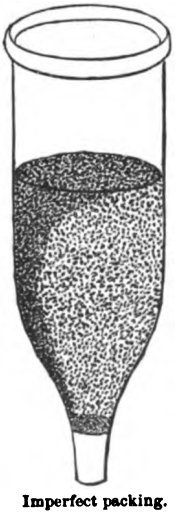
Fig. 305.



Scored paper.

The moistened powder should be carefully deposited in the percolator in layers, each succeeding layer being packed according to the directions, "moderately" or "firmly," as the case may be, care being taken to use the same degree of pressure with each layer.

Fig. 307.



Imperfect packing.

Fig. 308.

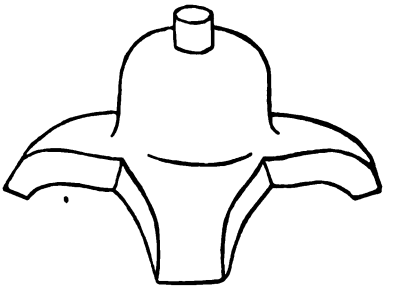
Proper packing.

Fig. 306 shows a convenient utensil for packing a percolator. It should be made of hard wood, preferably lignum-vitæ. The skill used in this part of the process will be proved by the manner in which the menstruum permeates the moistened powder. If the descent is regular and uniform, it is shown in a glass percolator by the line marking the descent of the menstruum being perfectly horizontal. If the line is irregular, it is easy to point out just where the pressure was insufficient or too great. Fig. 307 shows loose and irregular packing, too much pressure being made on the right side, the menstruum descending upon the left side unequally and escaping unsaturated. Fig. 308 illustrates a percolator which has been properly packed, the liquid descending uniformly.

Adding the Menstruum.—When the last portion of moistened powder is introduced into the percolator, a sheet of filtering-paper,

scored at the edges and slightly larger in diameter than the surface of the powder, should be laid upon it, for the purpose of causing the even distribution of the menstruum. A weight of some kind is usually placed upon the paper, to keep it from floating out of place. Clean pebbles, a bottle-stopper, or a glass funnel may be used, but in Fig. 309 is shown a glass tripod percolating weight, which has been made for this purpose by Whitall, Tatum & Co. It is easily cleaned, is not readily broken, and does not take up much room. Where the percolator is large enough to hold the whole of the menstruum, it may be at once added carefully. When this is not the case, and the menstruum must be added in divided portions, care must be observed to follow with the succeeding portion before the first has entirely disappeared, or otherwise fissures may appear in the powder, and the menstruum will of course then seek the outlet offering the least obstruction, and will leak through the fissures instead of percolating through the powder. This is more apt to occur in percolating very fine powders than in percolating coarse ones, although liable to take place in either. Where a large quantity of menstruum is required, a contrivance for continually supplying the menstruum should be used, in the form of an inverted bottle or flask (see Fig. 313), or any of the methods for continuous filtration (see Figs. 213 and 214) may be employed.

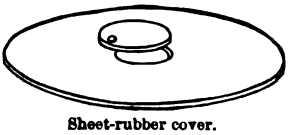
FIG. 309.



Percolating weight.

Previous Maceration is recommended when the structure of the powder is tough, when the soluble principles are not easily extracted by the menstruum, or when a comparatively large quantity of powder is to be exhausted by a small quantity of menstruum. It is obvious that maceration is going on constantly whilst the menstruum is traversing the powder during its gradual descent, and when the amount of menstruum is more than sufficient to exhaust the drug, previous maceration is merely a waste of time. Nevertheless, the framers of the Pharmacopœia, in order to prevent the possibility of an unskilful or ignorant operator's failing to exhaust a drug with the quantity of menstruum directed, have adopted in most cases the precaution of ordering previous maceration for a short time. This is best performed by moistening the drug, introducing it loosely into the percolator, and covering it closely to prevent loss by evaporation. This course has the additional advantage of allowing the drug to swell at the same time. A cover made of sheet-rubber (see Fig. 310), with a circular opening, is very useful in this connection. No attempt should ever be made to produce fluid extracts on the small scale without previous maceration.

FIG. 310.



Sheet-rubber cover.

Finishing the Process.—The officinal directions are frequently

definite in fixing the quantity of percolate to be received from a given quantity of powder, but the oft-repeated direction to "add the menstruum until the substance is exhausted" at once raises the question, When is a drug exhausted of its activity? This question can be properly answered only by knowing beforehand what the active principles of the drug are. A few examples will sufficiently illustrate this. The activity of nux vomica, opium, and cinchona resides in the bitter alkaloids: hence the *absence of bitterness* in the percolate in such cases indicates exhaustion. Cochineal and saffron are valued in pharmacy for nothing but the coloring-matter contained in them: hence the *absence of color* in the percolate indicates exhaustion. Catechu, galls, kino, krameria, etc., contain tannin, and this is the only valuable principle: the *absence of astringency* in the percolate in these cases, therefore, indicates exhaustion. The exhaustion of resinous drugs may be known by the absence of precipitation when the percolate is dropped into water. Where two or more active principles exist in a drug, the latter is not exhausted until the percolate is free from all of them. *The intelligent practice of the process of percolation, therefore, requires an accurate knowledge of the constituents and physical properties of medicinal substances.*

Choice of Menstrua.—Much labor has been bestowed by investigators in ascertaining the exact proportions of the usual solvents—water, alcohol, glycerin, etc.—that are best adapted for depriving drugs of such of their soluble principles as are desirable, and at the same time leaving untouched in the residue those principles which are either inert or objectionable. The special menstruum which is exactly adapted to the peculiar characteristics of the drug, and which will cause the retention of the soluble principles in a permanent form under the varying conditions of climate, and at the same time permit exposure to light, heat, and air without injury, can be determined only by experiment and experience. When new galenical preparations are proposed, the menstruum selected must therefore be merely tentative, and general principles must guide, until positive knowledge is secured. Alcohol would be indicated for active resinous drugs, diluted alcohol for simple bitter tonics, cathartics, etc., and diluted alcohol with glycerin for astringent drugs, etc. The selection of proper menstrua will be noticed, as occasion demands, in the chapters upon infusions, tinctures, abstracts, extracts, fluid extracts, etc.

Absorbed Menstruum.—The amount of menstruum which a powder will absorb and retain after percolation ceases can never be accurately predetermined. If it is important to know beforehand the percentage of menstruum capable of being absorbed, a practical trial should be made upon the small scale, using the same powder and menstruum.

Substances possess very different capacities for retaining menstruum: those having a light, spongy structure hold more than hard ligneous drugs, and even the same drug will often vary in its capacity in this respect, whilst the amount of moisture present in the drug before it is percolated is never a constant quantity, varying sometimes as much as eight to twenty per cent. The advantages of percolation over maceration are very apparent in respect to the character of the liquid left in the residue: in maceration the liquid left in the residue is finished tincture; in per-

colation it is merely menstruum, the active portions of the drug having been dissolved in the preceding percolate. In large operations, from an economical point of view, it is desirable to recover absorbed menstrua when the residues contain sufficient alcohol to make it worth the necessary time and labor. Distillation is then resorted to, or the residue is treated with weak alcohol and subsequently with water. Where water causes swelling of the substance and a stoppage of the percolation, the residue may be mixed with clean sawdust, rice chaff, or other inert dry substance, and then percolated with water. Recovered distilled alcohol may be purified by treating it with permanganate of potassium: twelve grains dissolved in a gallon of the percolate, and allowed to stand a few days, are usually sufficient: the purified alcohol may be decanted or filtered. Care must always be taken not to use unpurified recovered alcohol which is odorous on account of containing volatile oil obtained from a drug, or which may be otherwise impure.

Controlling the Flow of the Percolate.—The necessity for some method of controlling the flow of the percolate is apparent. In simple percolation this is effected by the degree of pressure used in packing the moistened drug, as has been previously explained. Judgment and experience are absolutely necessary to guide the operator. Various mechanical expedients have been used to accomplish the same purpose. In officinal percolation (see Fig. 297) the flow of the percolate is regulated by increasing or decreasing the difference in height between the end of the rubber delivery-tube and the height of the liquid in the percolator. In metallic percolators stop-cocks have been employed, but, owing to the difficulty of thoroughly cleaning them, their use has been almost entirely abandoned. In the following descriptions of special percolators it will be observed that the control of the flow of the percolate is one of the principal objects sought.

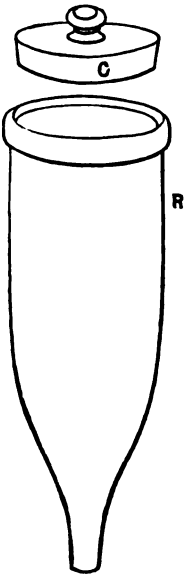
SPECIAL PERCOLATORS.

Stoppered Percolator.—Many modifications in the ordinary cylindrical or conical percolator have been suggested from time to time to suit special requirements. In Fig. 311 is shown a glass percolator proposed by Dursse, the special merit of which lies in the manner in which evaporation is prevented. This is effected by means of the ground-glass cover: the upper part of the percolator, R, is strengthened by a deep band; the glass cover, C, is carefully ground so as accurately to fit the percolator and make a nearly tight joint, which can be improved by moistening the edge with glycerin. If the percolate should flow too freely, it can generally be checked by screwing in the cover of the percolator; should it flow too slowly, a small piece of twine inserted between the cover and the side will permit the necessary pressure of the atmosphere. The graceful outlines of this percolator, and the evident care used in its manufacture, may be mentioned as points in its favor.

Well-tube Percolator.—An excellent method of percolation which has been used by Dr. E. R. Squibb for a number of years, and is still employed, is shown in Fig. 312. It is based upon the principle of drawing water from a well automatically as fast as it accumulates. This

is effected by the use of a well-tube placed in the centre of an ordinary jar or pot and held in its place by the powdered drug which is packed around it. The menstruum is poured upon the drug, and, after percolating through, collects in the well-tube, from which it is drawn off by an ingeniously-constructed syphon. The practical value of this method warrants a detailed description. It may be used for either large or small operations.

FIG. 811.



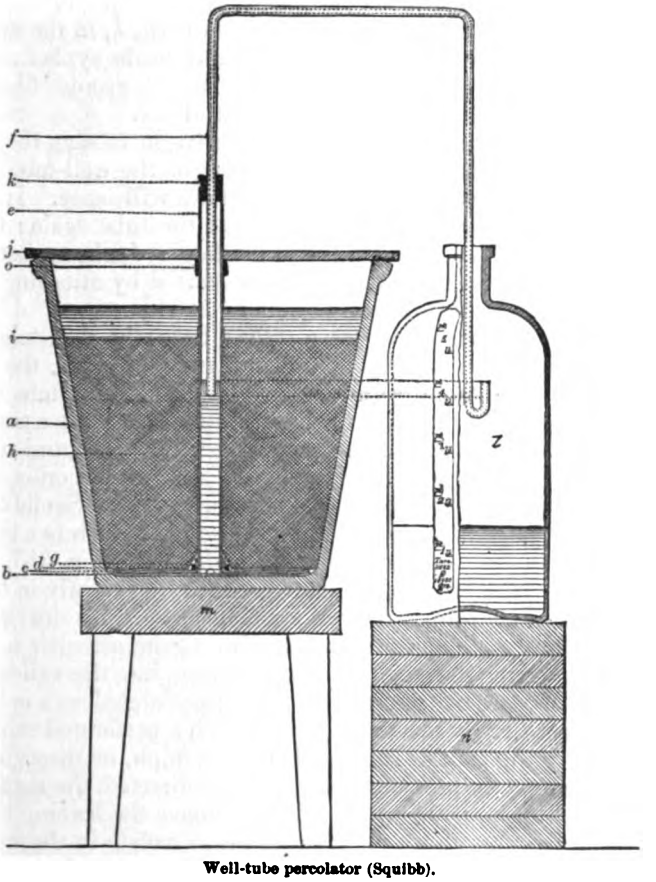
Durnee's percolator.

The percolator is a stone-ware pot of about two gallons' capacity, capable of holding six pounds of most drugs, and mounted on a suitable stand. A disk of blanket, *b*, is cut of such a size and shape as to lie flat upon the bottom and cover it entirely. Another disk, *c*, of the same material, but a little larger, is made with a crucial incision (X) in the centre, so that it may be stretched over the end of the well-tube, *e*. This is a piece of glass tube about twelve inches long, having an internal diameter of half an inch, and irregularly notched or gnawed off obliquely at the lower end. One end of this well-tube is pushed through the crucial cut in the centre of the upper disk of blanket, and this blanket is pushed to the other end of the tube, so that the corners made by the crucial cut are reflected up against the outside of the tube. These corners are then tied firmly to the tube by passing twine around them, or are secured by a stout rubber band, *g*, made of a section of rubber tubing of proper size. A disk of filtering-paper, *d*, larger than the upper blanket, *c*, with a crucial cut in the centre, and scored round the edge so as to lie flat against the sides of the percolator where reflected up against them, is pushed down upon the upper blanket, the well-tube passing through the cut in the centre. If now a cork be temporarily stuck into the well-tube to keep out the moistened powder, the percolator is ready to receive its charge, which is packed around the well-tube and upon the disks of paper and blanket so as to occupy the main body of the percolator, *h*, up to about the position of *i*. When the charge, having been properly moistened, rubbed, and sifted, so as to be entirely uniform and free from wet lumps, is packed around the well-tube loosely or firmly according to the nature of the substance and the menstruum, its surface is covered by a disk of muslin or paper, *i*, cut so as to lie flat and smoothly upon the surface. The object of this is to distribute the menstruum as it is poured on, and to prevent the stream from breaking up and deranging the surface. Should this paper disk show a tendency to float in the stratum of menstruum, it may be held down by a few fragments of glass. The percolator is then ready to receive the menstruum or weak percolate, and a stratum of the liquid should be carefully kept covering the entire surface until the whole mass of the substance to be percolated is saturated. The cork is to be taken from the well-tube before the liquid is poured on, and then the liquid will flow down into the substance like a piston, pushing the interstitial

air before it, the air passing out through the blankets and the well-tube; finally the liquid will rise in the well-tube until its surface is within an inch or so of the surface of the liquid outside.

The whole substance is now in a perfect condition for maceration, and the surface should be left covered with the liquid to the depth of at least half an inch. A short section of rather thick rubber tubing, *o*, should be stretched over the upper end of the well-tube, and slipped down so as to support the centre of the cover. A tightly-fitting cover, *j*, made

FIG. 312.



Well-tube percolator (Squibb).

of sheet-rubber a quarter of an inch thick, with a hole in the centre for the well-tube, is then put on. The syphon, *f*, is made of glass tubing of about an eighth of an inch bore, bent twice at right angles, the two legs being each about twelve inches long. The outer leg is a little longer than the inner one, and turned up upon itself for about three-quarters of an inch, as shown in Fig. 312. The legs should have only such a difference in length that the inner one will reach the bottom

of the well-tube when required, and when measured upon the outer one will reach to about midway of its turned-up end.

This construction prevents the syphon from emptying itself at any time, for when the liquid is drawn over by the syphon until the surface of liquid in the well-tube falls to a level with the end of the turned-up portion, as shown by the lines in Fig. 312, the columns of liquid in the syphon will be of equal length and will counterbalance each other, and the flow will cease without emptying the syphon. But as soon as the level of the liquid in the well is raised by fresh additions of menstruum on the substance, the flow will recommence at a rate proportionate to the difference of levels, and may be readjusted to the required rate by slipping the syphon up or down in the cork, *k*, in the upper end of the well-tube. This cork should be bored to fit the syphon so tightly as to hold it in any position, and should have a groove filed longitudinally on its outer side, to allow free exit of air.

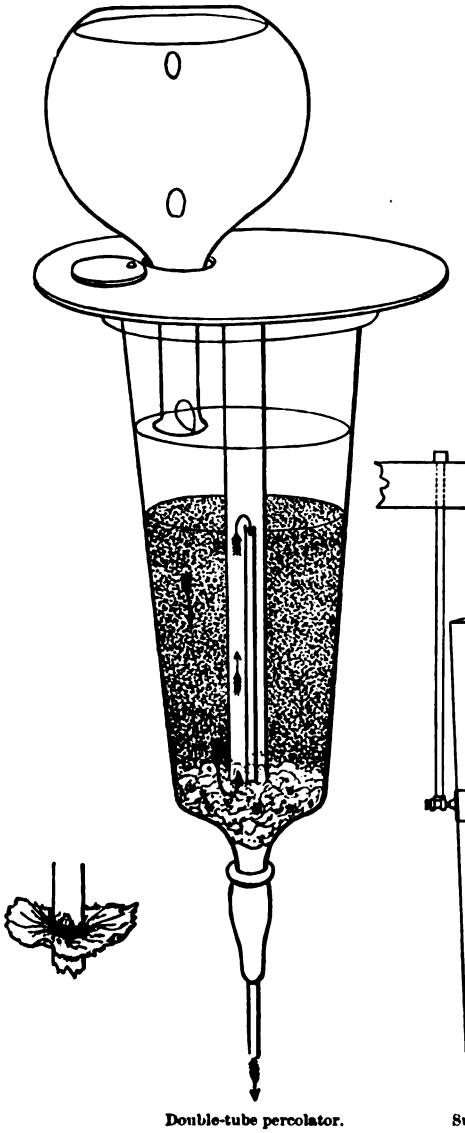
If it is desirable at any stage in the percolation to stop the process, the syphon may be gently lifted until the leg in the well-tube is above the level of the percolate there, when the flow will cease. It may be started by simply pushing the leg down into the tube again: this is a practical convenience which is greatly appreciated. If the syphon should accidentally empty itself, the flow is easily started by attaching a short rubber tube to the curved end and applying suction.

Double-tube Percolator.—This differs from the well-tube percolator just described in the use of an ordinary percolator, the absence of the syphon, and the substitution of a simple, straight tube which is free to move up or down inside of the well-tube at the discretion of the operator. Fig. 313 illustrates its mode of action. A central well-tube having the lower end irregularly broken is placed in an ordinary glass percolator, upon a tuft of absorbent cotton, or, as in Dr. Squibb's percolator, a circular piece of muslin is securely tied upon the tube a short distance from the bottom, as shown in the small cut in Fig. 313, and the end of the tube rests upon a perforated cork fitting tightly in the neck of the percolator, as proposed by W. S. Thomson in his description of a similar apparatus. The control of the flow of the percolate is effected by raising or lowering the small tube which passes into the well-tube, and which is held in place by passing through the perforated cork in the neck of the percolator already mentioned, or through a perforated rubber nipple slipped over the end, as suggested by Windolph, or through a piece of rubber tubing. If previous maceration is directed, the narrow tube may be pushed up until the upper orifice is above the level of the menstruum, and of course above the level of the percolate in the well-tube. When it is desirable to begin percolating, the tube is gently rotated with a downward movement until the level of the percolate is reached, and then percolation proceeds regularly, the course of the menstruum being indicated by the arrows in Fig. 313. The rapidity of the flow is increased by lowering the tube, and decreased by raising it.

Suspended Percolator.—In large operations it is necessary to employ means to facilitate not only the percolation, but also the packing and emptying and other subordinate but essential parts of the process. Fig. 314 shows a percolator in use by Hance Brothers & White. The

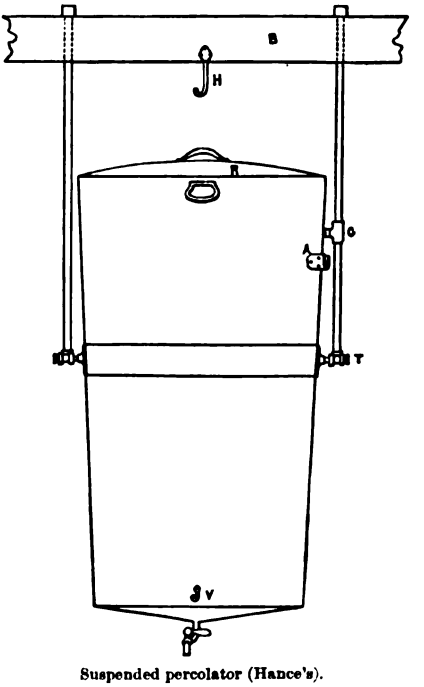
large percolator of tinned copper is suspended by trunnions, T, which are fastened to a stout band encircling the percolator slightly above the centre; two steam-pipe supports are secured to a strong beam, B, above, and the trunnions rest in tees, which are screwed to the end of the pipe-supports: the sliding tee, G, is dropped into the cup-shaped catch, A, when it is desired to retain the percolator in an upright position. The special advantage in this arrangement is observed, however, when an operation is concluded: a residue-car may then be wheeled opposite to the percolator, and the tee pushed up so as to permit the percolator to swing on the trunnions: the percolator may then be turned upside down

FIG. 313.



Double-tube percolator.

FIG. 314.



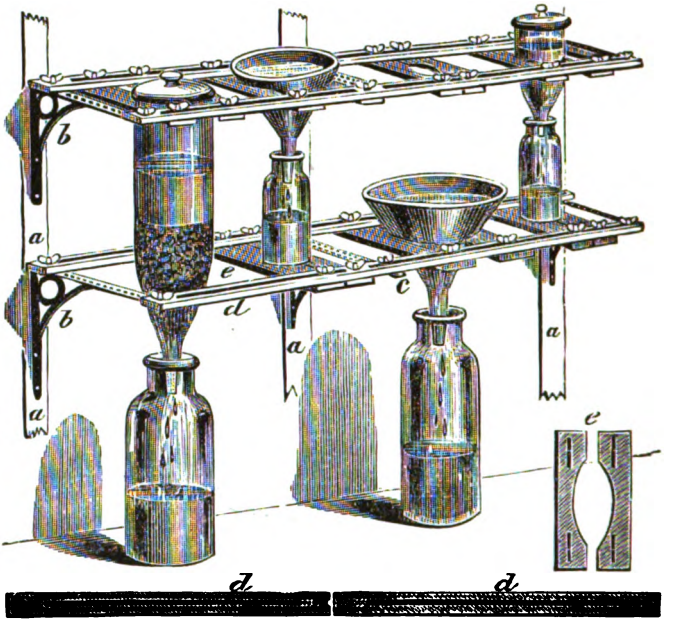
Suspended percolator (Hance's).

with the greatest ease, its conical shape facilitating the discharge of the residue.

Methods of Supporting Percolators.—The ordinary retort-stands

are often used to support percolators, but these are generally flimsy and unsatisfactory. The one shown in Fig. 152, particularly if used with split rubber-tube sections, as seen in Fig. 155, is much to be preferred. The stand shown in Fig. 315 was devised by the author in 1875, and has been in constant use since. It is conveniently fastened to the wall

FIG. 315.



Percolating stand.

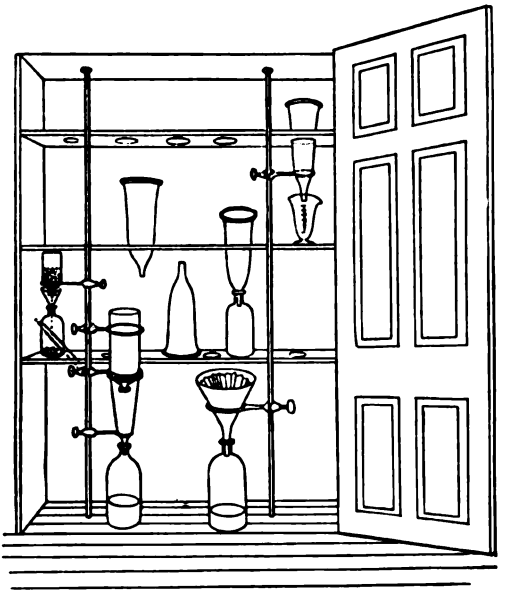
in front of the working counter. Two long strips having slots down the centre are supported on brackets, and short cross-strips having their inside edges hollowed out are fastened to the long strips by thumb-screws. This arrangement permits the adjustment of the cross-strips so that either a large or a small percolator or funnel can be supported, as shown in the cut, at any desired height. This stand is capable of enlargement by means of additional brackets and strips. If a wall counter is not available, a frame may be made extending over an ordinary counter, which will serve as well for a support, care being taken that the strips and frame are heavy enough to bear without strain any weight likely to be placed upon the stand. The special advantage of a percolating stand is, that it enables all percolating and filtering operations to be carried on with convenience in one place, thus saving time and labor.

Percolating Closet.—The retort-rings shown in Fig. 152 have been used by James T. Shinn in a convenient percolating closet, shown in Fig. 316. Two lengths of ordinary five-eighths-inch iron steam-pipe are fastened securely to the top and bottom of the closet, at a convenient distance from the shelves. The retort-rings may be adjusted to the desired height, and it is thus possible to carry on several percola-

tions or filtrations at the same time, away from the other operations of the shop, in a closet with a closed door.

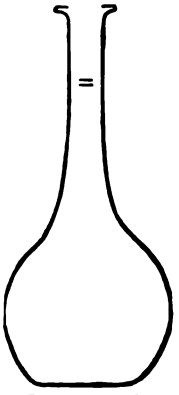
Receiving Bottles.—A series of bottles of various sizes should be reserved for use in receiving percolates. Where especial accuracy is necessary, a flask with a double mark on the neck should be used (see Fig. 317). Bottles with comparatively wide necks are to be preferred for receiving bottles. A paper strip may be pasted on the side, and accurately measured quantities of water poured in, carefully marking the height of each addition; upon the opposite side corresponding metric quantities may also be placed (see Fig. 318). Whitall, Tatum & Co. furnish receiving bottles in which the graduations are made on the surface of the glass with an engraver's wheel. These have the advantage of not being injured by washing in water, and in addition have a more elegant appearance (see Fig. 319).

FIG. 316.



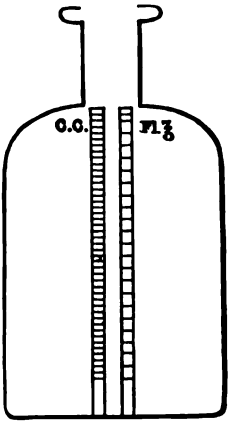
Percolating closet (Shinn).

FIG. 317.



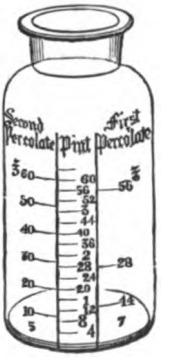
Receiving flask.

FIG. 318.



Receiving bottle.

FIG. 319.



Receiving bottle (all glass).

Repercolation, as its name indicates, is the process of percolating substances with percolates, or, as defined by Dr. E. R. Squibb, the author of the process, "the successive application of the same perco-

lating menstruum to fresh portions of the substance to be percolated." The principal object of repercolation is to effect the saving of alcohol and alcoholic menstrua by accomplishing the saturation of the menstrua, as nearly as possible, by passing the unsaturated or weaker percolate from one portion of the drug through another portion, and again passing the unsaturated or weaker percolate from this second portion through a third portion. The weak percolate from this last portion is generally set aside, to be used in succeeding operations upon the same drug in the place of fresh menstruum. This process is useful only in those operations where the relative proportion of menstruum used is small, as in the fluid extracts and similar concentrated preparations. Practical illustrations of the use of this process may be seen under Fluid Extracts.

Fractional Percolation is the term employed by Prof. C. Lewis Diehl and others to define percolation when applied to two successive portions of powder, the principle of action being identical with that of repercolation.

PART II.

OFFICINAL PHARMACY.

THE various processes which are used in making the officinal preparations having been considered in Part I., as solution, filtration, digestion, percolation, maceration, expression, etc., it is most appropriate now to take up these preparations and classify them. Those which form natural groups will be brought together in such a manner as to facilitate the study of their general features. Each chapter will begin with a definition and description of the class of preparations treated of; then will follow a table giving a succinct view of the individual preparations forming the class; and after this, the officinal processes will be found arranged alphabetically. Detailed comments upon the preparations are reserved for the subsequent chapters, the object being at this time to familiarize the student with the *various forms* of officinal preparations and fix their general characteristics upon the mind. The following diagram will serve to give a complete view of the classification: it should be carefully examined at the outset, and referred to again after the classes have been studied in detail.

OFFICINAL PREPARATIONS.[1]

LIQUIDS.		SOLIDS.	
Made without percolation or maceration.	Made by percolation or maceration.	Made by percolation or maceration.	Made without percolation or maceration.[2]
Aqueous Solutions.	**Aqueous Liquids.**	Extracts.	Powders.
Waters.	Infusions.	Abstracts.	Triturations.
Solutions.	Decoctions.	Resins.	Masses.
Aqueous Solutions containing Sweet or Viscid Substances.	**Alcoholic Liquids.**		Confections.
	Tinctures.		Pills.
Syrups.	Wines.		Troches.
Honeys.	Fluid Extracts.		*Cerates.*
Mucilages.	**Ethereal Liquids.**		*Ointments.*
Mixtures.	Oleoresins.		*Plasters.*
Glycerites.	**Acetous Liquids.**		*Papers.*
Alcoholic Solutions.	Vinegars.		Suppositories.
Spirits.			
Elixir.			
Ethereal Solutions.			
Collodions.			
Oleaginous Solutions.			
Liniments.			
Oleates.			

[1] Those used internally are in Roman type; those used externally, in Italics.

[2] The preparations in this class are mostly extemporaneous, and will be considered under Part V.

CHAPTER XXI.

AQUEOUS SOLUTIONS.

Aquæ. *Waters.*

THE class of preparations termed *waters* are known also as medicated, aromatic, or distilled waters, and may be simply defined as *aqueous solutions of volatile substances.* The German Pharmacopœia and French Codex, however, recognize as waters solutions of non-volatile substances. The volatile substances used in the preparation of waters are either solid, liquid, or gaseous, and the following methods have been employed in effecting their solution: 1. Simple solution in cold water. 2. Solution in hot water. 3. Filtration through an absorbent powder. 4. Percolation through cotton saturated with the substance. 5. Distillation.

Most of the medicated waters are used as pleasant vehicles and solvents for the administration of various remedies, and are solutions of aromatic volatile oils. There are *fifteen* officinal waters, including ordinary water.

1. **Simple Solution in Cold Water.**—This method is resorted to when the proportion of the volatile substance is small enough to dissolve *easily* in the quantity of water required. The process where a volatile liquid is the medicating substance is, to agitate it with the water until dissolved, and then to filter the solution. In the case of the gaseous solutions, the gas is passed through the water until a solution of the desired strength is obtained. (See Solution of Gases, p. 171.) Of the fourteen officinal waters, three are distilled, three are solutions of gases, six are solutions of volatile oils, one is a solution of a volatile solid, and one is a solution of a volatile liquid.

Officinal Waters made by Simple Solution.

Name.	Proportion of Liquid dissolved.	Uses and Dose.
Aqua Amygdalæ Amaræ.	0.1 per cent. of Oil of Bitter Almond.	Pleasantly flavored vehicle, fʒij.
Aqua Creasoti.	1 per cent. of Creasote.	Antiseptic and locally, fʒi to fʒiv.

Officinal Waters made by passing Gases through Water.

Name.	Proportion of Gas dissolved.	Uses.
Aqua Ammoniæ.	10 per cent. of gaseous Ammonia.	Stimulant, caustic.
Aqua Ammoniæ Fortior.	28 per cent. of gaseous Ammonia.	Rubefacient, escharotic.
Aqua Chlori.	0.4 per cent. of gaseous Chlorine.	Antiseptic, stimulant.

2. **Solution in Hot Water.**—This method is founded upon the fact that most of the volatile oils are much more soluble in hot water than in water of ordinary temperature: hence, if the volatile oil is thoroughly agitated with hot water in a metallic vessel, such as a tin can or a bottle, and allowed to stand until the excess has separated, if care is used the water will be found to be saturated: it may then be decanted and filtered.

3. **Filtration through an Absorbent Powder** is the process which has been most frequently employed: the object of using the powder is to divide thoroughly the oil, or volatile liquid, and expose a greater surface, so that the water in filtering through it may become thoroughly saturated. The powder most frequently used is magnesium carbonate, but this is sometimes objectionable on account of being slightly soluble in water. Calcium phosphate, kaolin, powdered glass, silica, powdered pumice-stone, charcoal, paper pulp, precipitated chalk, sugar, etc., have been suggested as substitutes, but there are quite as forcible objections to be urged against these as against the magnesium carbonate. Where solutions of alkaloids or nitrate of silver are needed, distilled water alone should be used. It is a source of regret that the method of making waters by filtration through an absorbent powder is no longer officinal.

4. **Percolation through Cotton impregnated with the Substance.**—This is the process directed to be used in the United States Pharmacopœia of 1880: it was recommended by W. S. Thompson, of Washington, D.C. The oil or volatile liquid is distributed upon the fibres of cotton, which are then pulled apart in order to secure thorough division; the saturated cotton is packed in a funnel, and the water poured upon it. In its passage downward the water dissolves the oil and passes out impregnated with the odorous substance. The presence of undissolved floating oily drops in the finished preparation has constituted one of the greatest objections to this process. It is an improvement to insert a plug of dry cotton in the throat of the funnel before placing the saturated cotton in position: this prevents the oily drops which may escape solution from being carried down by the water as it percolates through. Too much care cannot be exercised in selecting the volatile oils, which should be fresh and of the best quality.

Officinal Waters made by Percolation through Cotton impregnated with the Substance.

Name.	Proportion.	Use and Dose.
Aqua Anisi.	0.2 per cent. of Oil of Anise.	Pleasant vehicle, f℥i.
Aqua Camphoræ.	0.8 per cent. of Camphor dissolved in Alcohol.	Mild antispasmodic, f℥ss.
Aqua Cinnamomi.	0.2 per cent. of Oil of Cinnamon.	Pleasant vehicle, f℥i.
Aqua Fœniculi.	0.2 per cent. of Oil of Fennel.	Pleasant vehicle, f℥i.
Aqua Menthæ Piperitæ.	0.2 per cent. of Oil of Peppermint.	Pleasant vehicle, f℥i.
Aqua Menthæ Viridis.	0.2 per cent. of Oil of Spearmint.	Pleasant vehicle, f℥i.

5. **Distillation.**—This is the best process for preparing medicated waters, and should be used wherever practicable. If the fresh drug can be procured, it should always be used in preference to that which has been dried, because in the process of desiccation there is usually a loss of the agreeable volatile constituents. Metallic distillatory apparatus is preferably employed (see page 135). If the drug containing the oil-cells has a loose structure and is quickly penetrated by hot water, so that the oil-cells are easily ruptured, the drug may be introduced without previous contusion or grinding: it will usually be found, however, most economical to cut or grind the drug coarsely. Most distilled waters acquire an unpleasant empyreumatic odor as soon as they are distilled; this passes off gradually upon exposure to air, if care has been taken not to expose the drug to the action of direct heat during distillation. If no precautions are taken to protect the drug from partial burning, the odor of the carbonized substance will always be noticeable in the distilled water, rendering the product worthless. Fig. 170 shows a copper wire cage contrived by the author to obviate the difficulty just described: the surface of the cage is hemispherical; it rests, after being partially filled with the drug, upon the flat bottom of the still, and thus the contact of the substance with the heated surface is avoided: the meshes of the cage are coarse enough to permit the free passage of vapors and the boiling water through them. Although distillation by the use of steam may be most convenient upon the large scale, Vuaflart and Machet have shown that rose and orange-flower waters distilled over a naked fire keep better than those distilled by steam heat.

Preservation.—Distilled waters should not be made in larger quantities than can be used within a reasonable time, because they deteriorate when long kept, a flocculent precipitate forming in them, and ultimately they lose all traces of their usually agreeable odor. Microscopic plants belonging to the order Confervoideæ will often be found in medicated waters. These are usually tufts of articulated filaments, propagated by very minute spores from the atmosphere which have found lodgment in the water. Their presence renders the medicated water unsightly, and when in large proportion they must be regarded as injurious. If the aromatic water is heated and introduced into a bottle with a side opening near the bottom (like a douche-bottle) to which a rubber tube with a pinch-cock is attached, and a tuft of cotton pushed into the *neck* of the bottle, any spores originally present in the water will be killed by the heat, and the future growth of confervæ will be prevented by the interception of the spores by the cotton. It usually suffices, however, to heat the medicated water and introduce it at once into small bottles, which are to be completely filled, tightly sealed, and kept in a cool, dark place. Alcohol is sometimes added as a preservative, but this generally serves its purpose only a short time, as it cannot be added in sufficient quantity to preserve the water permanently, on account of its interference with the therapeutic action. The small percentage of alcohol in the medicated water is converted into acetic acid when long kept, and thus the preparation is soured. Glycerin and syrup have been suggested as preservatives. In the writer's experience they are not of much value unless used in large and inadmissible quantities.

Officinal Waters made by Distillation.

Name.	Proportion of Material used.	Uses and Dose.
Aqua Aurantii Florum.	40 per cent. Fresh Orange Flowers.	Mild sedative vehicle, f℥ss.
Aqua Destillata.	800 parts distilled from 1000 of water.	Solvent.
Aqua Rosæ.	40 per cent. of Pale Rose.	Pleasant vehicle, f℥i.

PRACTICAL PROCESSES FOR OFFICINAL WATERS.

AQUA AMYGDALÆ AMARÆ. *U.S.* Bitter Almond Water.

	By measure.
Oil of Bitter Almond, 1 part, or	15 minims.
Distilled Water, 999 parts, or	2 pints.
To make 1000 parts, or	2 pints.

Dissolve the Oil in the Distilled Water, and filter through a well-wetted filter.

AQUA ANISI. *U.S.* Anise Water.

	By measure.
Oil of Anise, 2 parts, or	30 minims.
Cotton, 4 parts, or	60 grains.
Distilled Water, a sufficient quantity,	
To make 1000 parts, or	2 pints.

Add the Oil to the Cotton, in small portions at a time, distributing it thoroughly by picking the Cotton apart after each addition; then pack it firmly in a conical percolator, and gradually pour on Distilled Water, until *one thousand parts* [or 2 pints] of percolate are obtained.

AQUA AURANTII FLORUM. *U.S.* Orange Flower Water.

	By measure.
Recent Orange Flowers, 40 parts, or	54 oz. av.
Water, 200 parts, or	16 pints.
To make 100 parts, or	8 pints.

Mix them, and, by means of steam, distil *one hundred parts* [or 8 pints]. Keep the product in well-stopped bottles, excluded from light.

AQUA CAMPHORÆ. *U.S.* Camphor Water.

	By measure.
Camphor, 8 parts, or	116 grains.
Alcohol, 16 parts, or	4 fl. dr.
Cotton, 16 parts, or	½ oz. av.
Distilled Water, a sufficient quantity,	
To make 1000 parts, or	2 pints.

Dissolve the Camphor in the Alcohol, and add the solution to the Cotton, in small portions at a time, distributing it thoroughly by picking the Cotton apart after each addition. Expose the Cotton to the air until the Alcohol has nearly evaporated; then pack it firmly

in a conical percolator, and gradually pour on Distilled Water, until *one thousand parts* [or 2 pints] of percolate are obtained.

Camphor water of officinal strength may be made by adding the camphor, in fine powder, to ice-cold water in a bottle, agitating occasionally during twenty-four hours, and filtering.

AQUA CHLORI. *U.S.* Chlorine Water.

An aqueous solution of Chlorine [Cl; 35.4], containing at least 0.4 per cent. of the gas.

	By measure.
Black Oxide of Manganese, 10 parts, or	80 grains.
Hydrochloric Acid, 40 parts, or	5 fl. dr.
Water, 75 parts, or	10 fl. dr.
Distilled Water, 400 parts, or	7 fl. oz.
To make . . . . . about	8 fl. oz.

Place the Oxide in a flask, add the Acid previously diluted with *twenty-five parts* [or 3¼ fl. dr.] of Water, and apply a gentle heat. Conduct the generated Chlorine, by suitable tubes, through the remainder of the Water contained in a small wash-bottle, to the bottom of a bottle having the capacity of *one thousand parts* [or 1 pint], into which the Distilled Water has been introduced, the neck of which is loosely stopped with cotton, and which is to be kept, during the operation, at a temperature of about 10° C. (50° F.). When the air has been entirely displaced by the gas, disconnect the bottle from the apparatus, and, having inserted the stopper, shake the bottle, loosening the stopper from time to time, until the gas ceases to be absorbed. If necessary, reconnect the bottle with the apparatus, and continue passing the gas and agitating, until the Distilled Water is saturated. Finally, pour the Chlorine Water into dark amber-colored, glass-stoppered bottles, which must be completely filled therewith, and keep them in a dark and cool place.

AQUA CINNAMOMI. *U.S.* Cinnamon Water.

	By measure.
Oil of Cinnamon, 2 parts, or	30 minims.
Cotton, 4 parts, or	60 grains.
Distilled Water, a sufficient quantity,	
To make 1000 parts, or	2 pints.

Add the Oil to the Cotton, in small portions at a time, distributing it thoroughly by picking the Cotton apart after each addition; then pack it firmly in a conical percolator, and gradually pour on Distilled Water until *one thousand parts* [or 2 pints] of percolate are obtained.

AQUA CREASOTI. *U.S.* Creasote Water.

	By measure.
Creasote, 1 part, or	70 minims
Distilled Water, 99 parts, or	q. s.
To make 100 parts, or	1 pint.

Agitate the Creasote with the Distilled Water until dissolved, and filter through a well-wetted filter.

AQUA DESTILLATA. *U.S.* Distilled Water.

	By measure.
Water, 1000 parts, or	25 pints.
To make 800 parts, or	20 pints.

Distil the Water from a suitable apparatus provided with a block-tin or glass condenser. Collect the first *fifty parts* [or 1¼ pints] and throw this portion away. Then collect *eight hundred parts* [or 20 pints] and keep the Distilled Water in glass-stoppered bottles.

AQUA FŒNICULI. *U.S.* Fennel Water.

	By measure.
Oil of Fennel, 2 parts, or	30 minims.
Cotton, 4 parts, or	60 grains.
Distilled Water, a sufficient quantity,	
To make 1000 parts, or	2 pints.

Add the Oil to the Cotton, in small portions at a time, distributing it thoroughly by picking the Cotton apart after each addition; then pack it firmly in a conical percolator, and gradually pour on Distilled Water, until *one thousand parts* [or 2 pints] of percolate are obtained.

AQUA MENTHÆ PIPERITÆ. *U.S.* Peppermint Water.

	By measure.
Oil of Peppermint, 2 parts, or	30 minims.
Cotton, 4 parts, or	60 grains.
Distilled Water, a sufficient quantity,	
To make 1000 parts, or	2 pints.

Add the Oil to the Cotton, in small portions at a time, distributing it thoroughly by picking the Cotton apart after each addition; then pack it firmly in a conical percolator, and gradually pour on Distilled Water, until *one thousand parts* [or 2 pints] of percolate are obtained.

AQUA MENTHÆ VIRIDIS. *U.S.* Spearmint Water.

	By measure.
Oil of Spearmint, 2 parts, or	30 minims.
Cotton, 4 parts, or	60 grains.
Distilled Water, a sufficient quantity,	
To make 1000 parts, or	2 pints.

Add the Oil to the Cotton, in small portions at a time, distributing it thoroughly by picking the Cotton apart after each addition; then pack it firmly in a conical percolator, and gradually pour on Distilled Water, until *one thousand parts* [or 2 pints] of percolate are obtained.

AQUA ROSÆ. *U.S.* Rose Water.

	By measure.
Recent, Pale Rose, 40 parts, or	48 oz. av.
Water, 200 parts, or	14 pints.
To make 100 parts, or	7 pints.

Mix them, and, by means of steam, distil *one hundred parts* [or 7 pints].

Liquores. *Solutions.*

Under this head the U. S. Pharmacopœia places all aqueous solutions of non-volatile substances except such as naturally form separate distinctive classes, as the syrups, infusions, and decoctions. Solution of Gutta-Percha is the only one in the class which is not prepared with the solvent water.

This classification is adopted only in the U. S. Pharmacopœia, the British standard embracing, in addition, gaseous and saccharine solutions, as Liquor Ammoniæ, Liquor Calcis Saccharatus, etc., whilst the German Pharmacopœia does not adopt any definite method, solutions of volatile and non-volatile substances both being in the class Aquæ and also in the class Liquores: Aqua Rosæ and Aqua Plumbi being together, and Liquor Ammonii Caustici and Liquor Natri Caustici being in the same class.

The officinal solutions constitute a most interesting group of preparations. They are usually very active medicinal agents, and some of them are powerful poisons. The number of officinal solutions is *twenty-six*. The following tables exhibit in condensed form a view of the class Liquores, U.S. P., arranged alphabetically in three classes: 1. Simple aqueous solutions, in which the solid dissolved is not altered in any respect, except so far as depends upon its external form. 2. Chemical aqueous solutions, or those in which the properties of the dissolved body or bodies are changed by chemical action or heat (see page 165). 3. Solution in chloroform.

LIQUORES, *U. S. P.*

1. Simple Solutions (aqueous).

Name.	Composition.
Liquor Acidi Arseniosi	1 per cent. As_2O_3, 2 per cent. HCl (U. S. P.).
Arsenii et Hydrargyri Iodidi	1 per cent. AsI_3, 1 per cent. HgI_2.
Calcis	Saturated Solution Ca2HO.
Ferri et Quininæ Citratis	32.5 per cent. Citrate of Iron and Ammonium, 6 per cent. Quinine, 14 per cent. Citric Acid, 15 per cent. Alcohol and Water.
Iodi Compositus	5 per cent. I, 10 per cent. KI.
Pepsini	4 per cent. Sacch. Pepsin, 1.2 per cent. HCl (U. S. P.), 40 per cent. Glycerin, and Water.
Plumbi Subacetatis Dilutus	3 per cent. Sol. Subacet. Lead.
Potassæ	5.6 per cent. Potassa (second formula).
Sodæ	5.6 per cent. Soda (second formula).
Sodii Arseniatis	1 per cent. Sodium Arseniate.
Sodii Silicatis	Nearly Saturated Solution.

2. Chemical Solutions (aqueous).

Name.	Composition.
Liquor Ammonii Acetatis	Dil. Acetic Acid with Ammonium Carbonate.
Ferri Acetatis	Ferric Hydrate with Glacial Acetic Acid and Water (33 per cent. Ferric Acetate).
Ferri Chloridi	Iron, HCl,HNO_3, and Water (37.8 per cent. Ferric Chloride).
Ferri Citratis	Ferric Hydrate with Citric Acid and Water (43 to 44 per cent. of Scaled Salt).
Ferri Nitratis	Ferric Hydrate with Nitric Acid and Water (6 per cent. Ferric Nitrate).

Name.	Composition.
Ferri Subsulphatis	Ferrous Sulphate, H_2SO_4,HNO_3, Water (43.7 per cent. of the Salt).
Ferri Tersulphatis	Ferrous Sulphate, $H_2SO_4HNO_3$, Water (28.7 per cent. of the Salt).
Hydrargyri Nitratis	40 per cent. Red Oxide of Mercury, 45 per cent. Nitric Acid, Water (about 50 per cent. Mercuric Nitrate).
Magnesii Citratis	Magnesium Carbonate, Citric Acid, Syrup of Citric Acid, Potassium Bicarbonate, Water.
Plumbi Subacetatis	Acetate of Lead, Oxide of Lead, Water (about 25 per cent. Subacetate of Lead).
Potassæ	Potassium Bicarbonate, Lime, Water (about 5 per cent. Potassa).
Potassii Citratis	Potassium Bicarbonate, Citric Acid, Water (about 9 per cent. Potassium Citrate).
Potassii Arsenitis	1 per cent. Arsenious Acid, 1 per cent. Potass. Bicarb., 3 per cent. Compound Tincture of Lavender, Water.
Sodæ	Sodium Carbonate, Lime, Water (about 5 per cent. Sodium Hydrate).
Sodæ Chloratæ	Sodium Carbonate, Chlorinated Lime Water (at least 2 per cent. available Chlorine).
Zinci Chloridi	Zinc, Nitric Acid, Precipitated Carbonate of Zinc, HCl, Water (about 50 per cent. Chloride of Zinc).

3. Solution in Chloroform.

Name.	Composition.
Liquor Gutta-Perchæ	9 per cent. Gutta Percha, 10 per cent. Carbonate of Lead.

The officinal solutions vary so greatly in their properties and method of preparation, that no general formula or remarks can be given here to aid the student in studying them individually which would compare in value with the careful consideration that should be given each separate formula. These processes will be found under the head of the bases entering into them in Part III. For general manipulations of solutions, see page 165.

CHAPTER XXII.

AQUEOUS SOLUTIONS CONTAINING SWEET OR VISCID SUBSTANCES.

Syrupi. *Syrups.*

SYRUPS are concentrated solutions of sugar in water or aqueous liquids. The liquids used sometimes contain acetic or other organic acids, and occasionally a small quantity of alcohol. When water *alone* is used in making the solution of sugar, the preparation is termed *syrup*, or *simple syrup*. When the water contains soluble principles from various medicinal substances, the syrup is called a *medicated* syrup. A *flavored syrup* is one which is not medicinal in its action, but which is made by the introduction of various aromatic or pleasantly-flavored substances. Syrups are useful preparations, because their sweet taste facilitates administration, whilst the presence of a large percentage of sugar renders them permanent if they are properly made.

Selection of the Sugar.—The sugar which should be used exclusively in making syrups is clearly defined by the Pharmacopœia. It is described as in white, dry, hard, distinctly crystalline granules, permanent in the air, odorless, having a purely sweet taste, and a neutral reaction. This description corresponds with the sugar known commercially as "granulated," and the officinal tests prescribed should be carefully observed. (See Saccharum.) The direction that the sugar should be dry is all-important, because the permanency of syrups largely depends upon their containing the correct proportion of sugar and water. If an insufficient amount of sugar is present, the syrups will ferment; if they contain too much, crystallization of the excess takes place at first, whilst the subsequent growth of the crystals is accompanied by an abstraction of sugar from the liquid, and the result is such a weakening of the syrup that fermentation results, as in the first instance. *Damp sugar* should never be used unless the amount of moisture has been carefully ascertained, and an allowance made for it.

Preparation of Syrups.—Syrups are prepared in various ways, and the choice of the proper method must always depend upon the physical and chemical characteristics of the substances entering into the preparation. Four methods are officinally recognized, which may be summarized as follows: 1. By solution with heat. 2. By agitation without heat. 3. By simple addition of medicating liquid to syrup. 4. By digestion or maceration. Another method, and for many syrups the best process, is percolation (sometimes called the cold process).

1. **By Solution with Heat.**—This is the usual method of making syrups when the valuable constituent is not volatile nor injured by heat, and when it is desirable to make the syrup rapidly. The sugar is usually dissolved in the water or aqueous solution and heated until solution is effected, skimmed, strained, and the proper quantity of water added to make the desired weight or measure. If the syrup is made from an infusion, a decoction, or an aqueous solution containing organic matter, it is usually proper to heat the syrup to the boiling-point, in order to coagulate albuminous matter: this is separated subsequently by straining. If the albumen or other impurities were suffered to remain in the syrup, fermentation would probably be induced in warm weather. Saccharometers (see page 71) are very useful in making syrups by the hot process where the specific gravity of the finished syrup is known. This instrument may be floated in the syrup *whilst boiling*, and thus the exact degree of concentration determined without waiting to cool the syrup and having to heat it again subsequently to concentrate it further.

2. **By Agitation without Heat.**—This process is directed by the Pharmacopœia to be used in those cases where there is likelihood of loss of valuable volatile constituents. It is the principal cold process adopted by the Pharmacopœia. The aqueous solution is usually directed to be added to the sugar in a bottle, and the whole well shaken together until the sugar is dissolved. This is best effected by allowing the tightly-corked bottle to lie upon its side during the intervals of agitation.

3. **By the Simple Addition of Medicating Liquid to Syrup.**—This method is resorted to in those cases in which fluid extracts, tinctures, or other liquids are added to syrup in order to medicate it. Syrups made in this way usually show precipitates in time, owing to the fact that alcohol enters into most of the liquids thus used, and the resinous and oily substances dissolved by the alcohol often precipitate when mixed with the syrup, producing unsightly preparations.

4. **By Maceration or Digestion.**—But one officinal syrup is made by digestion,—*i.e.*, syrup of tolu. This method, as shown in this preparation, is not recommended as either accurate or efficient. A solution of a comparatively insoluble substance, like balsam of tolu, can always be effected in a more rapid and thorough manner by dissolving the substance in alcohol, mixing the tincture with sugar, and then getting rid of the alcohol subsequently by evaporation, or by the simpler and better method of suspending the resinous tincture in a mixture of magnesium carbonate and water, filtering, and retaining the small proportion of alcohol in the finished syrup. The process of maceration *without* digestion is used in making the officinal syrup of tar, and consists simply in stirring the purified tar with boiling distilled water, macerating for thirty-six hours, decanting the solution, and filtering.

Percolation in making Syrups.—This method originated with Orynski, and is conducted as follows. Into the lower orifice of an ordinary percolator is introduced a small piece of sponge, the sugar (granulated) is then poured in, and upon this the water, the apparatus being arranged as is usual in the process of percolation. The percolator may be covered loosely, and the operation will proceed without further attention, the syrup coming through drop by drop. If it should be

necessary to use crushed sugar, the percolator must be corked at the lower orifice, and the sugar and water introduced and allowed to macerate until the former has dissolved down to *half its bulk*, when the cork may be removed and the liquid be allowed to drop. If, after the liquid has all passed, there remains a quantity of undissolved sugar in the percolator, enough percolate may be poured back to dissolve it, afterwards adding sufficient water to bring the whole up to the required measure.

To be successful in using this process, care in several particulars must be exercised: 1. The percolator used should be cylindrical or semi-cylindrical, and cone-shaped as it nears the lower orifice. 2. The sugar must be coarse, else it will form into a compact mass, which the liquid cannot permeate. 3. The sponge must be introduced with care. If pressed too tightly in, it will effectually stop the process; if inserted too loosely, the liquid will pass too rapidly, and will, in consequence, be weak and turbid (from imperfect filtration).

Preservation of Syrups.—Syrups should never be made in larger quantities than can be used within a few months, except in those cases where special facilities can be employed for their preservation. A low temperature is the best preservative for syrups: concentration without supersaturation is also a condition favorable to preservation. The addition of substances like boric acid or salicylic acid, alcohol, sulphite of lime, etc., to prevent the fermentation of syrups, is not recommended, for if used in sufficient quantity to act as preservatives they communicate their own flavor to the syrup, or are otherwise objectionable. The practice of restoring syrups which have been spoiled through fermentation by heating them and "working them over" is a reprehensible one. The practice of good pharmacy demands the possession of sufficient moral courage to find a place for fermented syrups where they will do the least harm,—*i.e.*, in the sink and gutter-pipe.

A simple and practical method of preserving syrups, which is very effective, is as follows. A number of bottles are provided holding not more than a pint each, even when the quantity of syrup is large; the bottles are thoroughly cleaned, and kept hot by immersion in boiling water until ready for use; and a sufficient number of good corks, which have been thoroughly soaked in hot water, and of the proper size for the bottles, should be at hand. The syrup should be heated to the boiling-point (strained, if necessary, and reheated), and poured into the hot bottles until they are filled to the brim. The corks are inserted by forcibly pressing them into the necks of the bottles, thereby displacing a small portion of the syrup, and are tied down with twine in the usual manner. Then, whilst the necks of the bottles are still hot (and before the syrup can contract in volume through cooling) they are dipped into melted sealing-wax contained in a suitable vessel. By this method the germs which are supposed to produce fermentation are destroyed by the heat, and no air can find its way to the syrup, as the bottles are hermetically sealed. Fruit-juices may be preserved in the same way.

Officinal Syrups.—There are thirty-four officinal syrups. Of this number FIVE are made by *solution with heat*, NINE by the *simple addition of medicating liquid to syrup*, EIGHTEEN by the *agitation of the sugar with the medicating liquid without heat*, and TWO by *maceration or digestion*.

Table of Officinal Syrups, arranged in Classes according to the Methods employed in their Preparation.

(The abbreviation p. means parts.)

Name and Method of Preparation.	Sub-Classes.	Proportions.
Solution with Heat.		
Syrupus.		65 p. Sugar; Distilled Water to 100 p.
Calcis.		5 p. Lime; 30 p. Sugar; Water to make 100 p.
Ferri Bromidi.	Solution involving chemical action preserved by sugar.	10 p. Ferrous Bromide; 60 p. Sugar; Distilled Water to 100 p.
Ferri Iodidi.	" "	10 p. Ferrous Iodide; 60 p. Sugar; Distilled Water to 100 p.
Rubi Idæi.	From pressed and fermented raspberry juice.	40 p. Filtered Juice; 60 p. Sugar.
Simple Addition of Medicating Liquid to Syrup.		
Syrupus Acaciæ.	With mucilage.	25 p. Mucilage; Syrup to 100 p.
Acidi Citrici.	With flavored acidulated solution.	8 p. Citric Acid; 4 p. Spirit of Lemon; 8 p. Water; Syrup to 1000 p.
Rhei Aromaticus.	With aromatic tincture.	10 p. Aromatic Tincture of Rhubarb; Syrup to 100 p.
Ipecacuanhæ.	With fluid extract.	5 p. Fluid Extract Ipecac; 95 p. Syrup.
Krameriæ.	" "	35 p. Fluid Extract Krameria; 65 p. Syrup.
Lactucarii.	" "	5 p. Fluid Extract Lactucarium; 95 p. Syrup.
Rosæ.	" "	10 p. Fluid Extract Rose; 90 p. Syrup.
Rubi.	" "	20 p. Fluid Extract of Rubus; 80 p. Syrup.
Senegæ.	" "	160 p. Fluid Extract Senega; 4 p. Water of Ammonia; 600 p. Sugar; Water to make 1000 p.
Agitation of Sugar with Medicating Liquid without Heat.		
Syrupus Allii.	Containing acetic acid.	15 p. Garlic; 60 p. Sugar; 40 p. Diluted Acetic Acid.
Scillæ.	" "	40 p. Vinegar of Squill; 60 p. Sugar.
Althææ.	From cold aqueous infusion.	4 p. Althæa; 60 p. Sugar; Water to 100 p.
Pruni Virginianæ.	" "	12 p. Wild Cherry; 5 p. Glycerin; 60 p. Sugar; Water to 100 p.
Rhei.	" "	90 p. Rhubarb; 6 p. Carbonate Potassium; 18 p. Cinnamon; 600 p. Sugar; Water to 1000 p.
Sennæ.	Infusion made by digestion.	33 p. Senna; 60 p. Sugar; 4 p. Alcohol; Oil of Coriander 1 per cent. of the amount of Alcohol; Water to 100 p.
Amygdalæ.	From emulsion.	10 p. Sweet Almond; 3 p. Bitter Almond; 50 p. Sugar; 5 p. Orange Flower Water; Water to 100 p.
Limonis.	From juice.	40 p. Lemon Juice; 2 p. Lemon Peel; 60 p. Sugar.
Aurantii.	Medicated water from tincture.	5 p. Sweet Orange Peel; 60 p. Sugar; Water to make 100 p.

Table of Officinal Syrups, etc.—(*Continued.*)

Name and Method of Preparation.	Sub-Classes.	Proportions.
Syrupus Sarsaparillæ Compositus.	Medicated water from tincture.	150 p. Sarsaparilla; 20 p. Guaiacum Wood; 12 p. Pale Rose; 12 p. Glycyrrhiza; 12 p. Senna; 6 p. Sassafras; 6 p. Anise; 6 p. Gaultheria; 600 p. Sugar; Diluted Alcohol and Water to make 1000 p.
Scillæ Compositus.	" "	120 p. Squill; 120 p. Senega; 3 p. Tartrate of Antimony and Potassium; 1200 p. Sugar; 9 p. Precipitated Phosphate of Calcium; Diluted Alcohol and Water to 2000 p.
Zingiberis.	Medicated water from fluid extract.	2 p. Fluid Extract of Ginger; 65 p. Sugar; Water to 100 p.
Aurantii Florum.	Simple admixture or solution.	35 p. Orange Flower Water; 65 p. Sugar.
Ferri Quininæ et Strychninæ Phosphatum.	" "	133 p. Phosphate of Iron; 133 p. Quinine; 4 p. Strychnine; 800 p. Phosphoric Acid; 6000 p. Sugar; Distilled Water to 10,000 p.
Hypophosphitum.	" "	35 p. Hypophosphite of Calcium; 12 p. Hypophosphite of Sodium; 12 p. Hypophosphite of Potassium; 1 p. Citric Acid; 2 p. Spirit of Lemon; 500 p. Sugar; Water to 1000 p.
Hypophosphitum cum Ferro.	" "	1 p. Lactate of Iron; 99 p. Syrup of Hypophosphites.
Acidi Hydriodici.	Solution involving chemical reaction.	1 per cent. Absolute Hydriodic Acid; Syrup; Spirit of Orange; Sugar; Distilled Water to 1000 p.
Calcii Lactophosphatis.	"	22 p. Precipitated Phosphate of Calcium; 33 p. Lactic Acid; 80 p. Orange Flower Water; 600 p. Sugar; Hydrochloric Acid; Water of Ammonia; Water to make 1000 p.
By Maceration or Digestion.		
Syrupus Picis Liquidæ.		6 p. Tar; 12 p. Cold Water; 50 p. Boiling Distilled Water; 60 p. Sugar.
Tolutanus.		4 p. Tolu; 65 p. Sugar; Distilled Water to make 100 p.

SYRUPUS. *U.S.* Syrup.

	By measure.
Sugar, in coarse powder, 65 parts, or	5 lb. av.
Distilled Water, a sufficient quantity,	
To make 100 parts, or	5 pt. 10 fl. oz.

Dissolve the Sugar, with the aid of heat, in *thirty-five parts* [or 40 fl. oz.] of Distilled Water, raise the temperature to the boiling point, and strain the solution while hot. Then incorporate with the solution enough Distilled Water, added through the strainer, to make the Syrup weigh *one hundred parts* [or measure 5 pints 10 fl. oz.].

Syrup thus prepared has the sp. gr. 1.310.

SYRUPUS ACACIÆ. *U.S.* Syrup of Acacia.

	By measure.
Mucilage of Acacia, 25 parts, or	4½ fl. oz.
Syrup, 75 parts, or	12 fl. oz.
To make 100 parts, or . . . about	1 pint.

Mix them.

This Syrup should be freshly made, when required for use.

SYRUPUS ACIDI CITRICI. *U.S.* Syrup of Citric Acid.

	By measure.
Citric Acid, 8 parts, or	150 grains.
Water, 8 parts, or	3 fl. dr.
Spirit of Lemon, 4 parts, or	100 minims.
Syrup, 980 parts, or	2 pints.
To make 1000 parts, or . . . about	2 pints.

Mix the Spirit of Lemon with the Syrup contained in a bottle; then add, gradually, the Citric Acid dissolved in the Water, shaking the bottle after each addition until the whole is thoroughly mixed.

SYRUPUS ACIDI HYDRIODICI. *U.S.* Syrup of Hydriodic Acid.

A syrupy liquid containing 1 per cent. of absolute Hydriodic Acid [HI; 127.6].

	By measure.
Iodine, 10 parts, or	95 grains.
Alcohol, 80 parts, or	2 fl. oz.
Syrup, 150 parts, or	2½ fl. oz.
Sugar, 500 parts, or	11 oz. av.
Spirit of Orange, 5 parts, or	1 fl. dr.
Distilled Water, a sufficient quantity,	
To make 1000 parts, or	1 pint.

Dissolve the Iodine in the Alcohol, with a very gentle heat, in a loosely stoppered flask, avoiding loss of Iodine from vaporization. Add the solution to the Syrup, previously mixed with *one hundred and fifty parts* [or 3 fl. oz.] of Distilled Water, and pass through the mixture a current of hydrosulphuric acid gas, until it acquires a pure yellowish color, and ceases to turn brown on shaking. Filter the liquid through white filtering paper, returning the first portions until it runs clear; wash the filter with a little Distilled Water, and evaporate the filtrate and washings, in a tared porcelain capsule, on a water-bath, at a temperature not exceeding 55° C. (131° F.), constantly stirring, until all odor of hydrosulphuric acid has disappeared. Then set the capsule aside, well covered, and allow the contents to cool. When cold, add the Spirit of Orange, the Sugar, and enough Distilled Water to make the whole weigh *one thousand parts* [or measure 1 pint]. When the Sugar has been dissolved, by stirring, strain the Syrup through a pellet of cotton placed in the neck of the funnel, which is to be kept covered, and transfer the filtered Syrup to small vials, which should be completely filled, securely corked, and kept in a cool and dark place.

A transparent, colorless or not more than pale straw-colored liquid, odorless, having a sweet and acidulous taste, and an acid reaction. Sp. gr. 1.300. If disulphide of

carbon be poured into a small portion of the Syrup, a little chlorine water then added, and the whole agitated, the disulphide will separate with a violet color.

Gelatinized starch added to the Syrup should not impart to it more than a faint bluish tint (abs. of more than traces of free iodine). Test-solution of chloride of barium, added to a portion of the Syrup, should produce no precipitate (abs. of sulphuric acid). Test-solution of nitrate of silver produces a precipitate which is nearly insoluble in water of ammonia (abs. of hydrochloric acid).

31.9 Gm. of Syrup of Hydriodic Acid should require, for complete precipitation, 25 C.c. of the volumetric solution of nitrate of silver.

SYRUPUS ALLII. *U.S.* Syrup of Garlic.

	By measure.
Fresh Garlic, sliced and bruised, 15 parts, or	7 oz. av.
Sugar, in coarse powder, 60 parts, or	28 oz. av.
Diluted Acetic Acid, 40 parts, or	18 fl. oz.
To make 100 parts, or about	2 pints.

Macerate the Garlic with *twenty-five parts* [or 11 fl. oz.] of the Diluted Acetic Acid, in a glass vessel, for four days, and express the liquid. Then mix the residue with the remainder of the acid, and again express, until enough additional liquid has been obtained to make the whole, when filtered, weigh *forty parts* [or measure 18 fl. oz.]. Lastly, pour the filtered liquid upon the Sugar contained in a suitable bottle, and agitate until it is dissolved.

Keep the Syrup in well-stopped, filled bottles, in a cool place.

SYRUPUS ALTHÆÆ. *U.S.* Syrup of Althæa.

	By measure.
Althæa, cut into small pieces, 4 parts, or	1 oz. av.
Sugar, in coarse powder, 60 parts, or	15 oz. av.
Water, a sufficient quantity,	
To make 100 parts, or about	1 pint.

Having washed the Althæa with cold Water, pour upon it *sixty parts* [or 14 fl. oz.] of cold Water, and macerate for one hour, stirring frequently; then drain through flannel, without expressing. To *forty parts* [or 9 fl. oz.] of the drained liquid add the Sugar, and dissolve it by agitation, without heat.

This Syrup should be freshly made, when required for use.

SYRUPUS AMYGDALÆ. *U.S.* Syrup of Almond.

	By measure.
Sweet Almond, 10 parts, or	5 oz. av.
Bitter Almond, 3 parts, or	1½ oz. av.
Sugar, in coarse powder, 50 parts, or	25 oz. av.
Orange Flower Water, 5 parts, or	2½ fl. oz.
Water, a sufficient quantity,	
To make 100 parts, or	2 pints.

Having blanched the Almonds, rub them in a mortar to a very fine paste, adding, during the trituration, *three parts* [or 1½ fl. oz.] of Water and *ten parts* [or 5 oz. av.] of Sugar. Mix the paste thoroughly with the Orange Flower Water and *thirty parts* [or 15 fl. oz.] of Water, strain with strong expression, and add enough Water to the dregs to obtain, after renewed expression, *sixty parts* [or 25 fl. oz.] of strained liquid. To this add the remainder of the Sugar, dissolve it by agitation without heat, and strain through muslin.

Keep the Syrup in well-stopped, filled bottles, in a cool place.

SYRUPUS AURANTII. *U.S.* Syrup of Orange.

	By measure.
Sweet Orange Peel, deprived of the inner, white layer, and cut into small pieces, 5 parts, or	2½ oz. av.
Alcohol, 5 parts, or	3 fl. oz.
Precipitated Phosphate of Calcium, 1 part, or	½ oz. av.
Sugar, 60 parts, or	28 oz. av.
Water, a sufficient quantity,	
To make 100 parts, or about	2 pints.

Macerate the Orange Peel with the Alcohol for seven days; then express the liquid. Rub this with the Precipitated Phosphate of Calcium and *thirty parts* [or 13 fl. oz.] of Water, gradually added; filter the mixture, and pass enough Water through the filter to make the filtrate weigh *forty parts* [or measure 17 fl. oz.]. Lastly, add the Sugar, dissolve it by agitation, without heat, and strain.

SYRUPUS AURANTII FLORUM. *U.S.* Syrup of Orange Flowers.

	By measure.
Orange Flower Water, 35 parts, or	½ pint.
Sugar, in coarse powder, 65 parts, or	16 oz. av.
To make 100 parts, or about	1 pint.

Dissolve the Sugar in the Orange Flower Water by agitation, without heat.

SYRUPUS CALCII LACTOPHOSPHATIS. *U.S.* Syrup of Lactophosphate of Calcium.

	By measure.
Precipitated Phosphate of Calcium, 22 parts, or	1 oz. av.
Lactic Acid, 33 parts, or	9½ fl. dr.
Orange Flower Water, 80 parts, or	3 fl. oz
Sugar, in coarse powder, 600 parts, or	28 oz. av.
Hydrochloric Acid,	
Water of Ammonia,	
Water, each, a sufficient quantity,	
To make 1000 parts, or about	2 pints.

To the Precipitated Phosphate of Calcium, mixed with *three hundred parts* [or 13 fl. oz.] of cold Water, add enough Hydrochloric Acid to dissolve it. Filter the solution, dilute it with *twelve hundred parts* [or 3 pints] of cold Water, and then add Water of Ammonia, until it is slightly in excess. Transfer the mixture at once to a fine, wetted muslin strainer. As soon as the liquid has run off, return the magma to the vessel, mix it quickly with *twelve hundred parts* [or 3 pints] of cold Water, and again transfer it to the strainer. When it has drained, mix the magma at once with the Lactic Acid, and stir until it is dissolved. Then add the Orange Flower Water and enough Water to make the solution weigh about *three hundred and fifty parts* [or measure 14 fl. oz.], filter, and pass enough Water through the filter to make the filtrate weigh *four hundred parts* [or measure 17 fl. oz.]. Lastly, add to this the Sugar, dissolve it by agitation, without heat, and strain.

SYRUPUS CALCIS. *U.S.* Syrup of Lime.

	By measure
Lime, 5 parts, or	1 oz. av.
Sugar, in coarse powder, 30 parts, or	6 oz. av.
Water, a sufficient quantity,	
To make 100 parts, or	20 oz. av.

Triturate the Lime and Sugar thoroughly in a mortar; then add the mixture to *fifty parts* [or 10 fl. oz.] of boiling Water, contained in a bright, copper or tinned-iron vessel, and boil the mixture for five minutes, constantly stirring. Dilute it with an equal volume of Water, and filter through white paper. Finally, evaporate the Syrup to *one hundred parts* [or 20 oz. av.].

SYRUPUS FERRI BROMIDI. *U.S.* Syrup of Bromide of Iron.

A syrupy liquid containing 10 per cent. of Ferrous Bromide [$FeBr_2$; 215.5].

	By measure.
Iron, in the form of fine wire, and cut into small pieces, 30 parts, or	1½ oz. av.
Bromine, 75 parts, or	9 fl. dr.
Sugar, in coarse powder, 600 parts, or	28 oz. av.
Distilled Water, a sufficient quantity,	
To make 1000 parts, or about	2 pints.

Introduce the Iron into a flask of thin glass of suitable capacity, add to it *two hundred parts* [or 9 fl. oz.] of Distilled Water and afterward the Bromine. Shake the mixture occasionally, until the reaction ceases and the solution has acquired a green color and has lost the odor of Bromine. Place the Sugar in a porcelain capsule and filter the solution of bromide of iron into the Sugar. Rinse the flask and Iron wire with *ninety parts* [or 4 fl. oz.] of Distilled Water, and pass the washings through the filter into the Sugar. Stir the mixture with a porcelain or wooden spatula, heat it to the boiling point on a sand-bath, and, having strained the Syrup through linen into a tared bottle, add enough Distilled Water to make the product weigh *one thousand parts* [or measure 2 pints]. Lastly, shake the bottle and transfer its contents to small vials, which should be completely filled, securely corked, and kept in a place accessible to daylight.

A transparent, pale-green liquid, odorless, having a sweet, strongly ferruginous taste, and a neutral reaction. With test-solution of ferricyanide of potassium it yields a blue precipitate. If a little disulphide of carbon be added to the Syrup, then a few drops of chlorine water, and the whole agitated, the disulphide will separate with a yellow or brown color. It should not deposit a sediment on keeping, and should not tinge gelatinized starch yellow (abs. of free bromine).

5.39 Gm. of the Syrup should require for complete precipitation, 50 C.c. of the volumetric solution of nitrate of silver (corresponding to 10 per cent. of ferrous bromide).

SYRUPUS FERRI IODIDI. *U.S.* Syrup of Iodide of Iron.

A syrupy liquid containing 10 per cent. of Ferrous Iodide [FeI_2; 309.1].

	By measure.
Iron, in the form of fine wire, and cut into small pieces, 25 parts, or	266 grains.
Iodine, 82 parts, or	2 oz. av.
Sugar, in coarse powder, 600 parts, or	14 oz. av.
Distilled Water, a sufficient quantity,	
To make 1000 parts, or . . . measure	1 pint.

Introduce the Iron into a flask of thin glass of suitable capacity, add to it *two hundred parts* [or 5 fl. oz.] of Distilled Water and afterward the Iodine. Shake the mixture occasionally, until the reaction ceases and the solution has acquired a green color and has lost the odor of Iodine. Place the Sugar in a porcelain capsule and filter the solution of iodide of iron into the Sugar. Rinse the flask and Iron wire with *ninety parts* [or 2 fl. oz.] of Distilled Water, and pass the washings through the filter into the Sugar. Stir the mixture with a porcelain or wooden spatula, heat it to the boiling point on a sand-bath, and, having strained the Syrup through linen into a tared bottle, add enough Distilled Water to make the product weigh *one thousand parts* [or measure 1 pint]. Lastly, shake the bottle and transfer its contents to small vials, which should be completely filled, securely corked, and kept in a place accessible to daylight.

A transparent, pale-green liquid, odorless, having a sweet, strongly ferruginous taste, and a neutral reaction. With test-solution of ferricyanide of potassium it yields a blue precipitate. If a little disulphide of carbon be added to the Syrup, then a few drops of chlorine water, and the whole agitated, the disulphide will separate with a purple or violet color. It should not deposit a sediment on keeping, and should not tinge gelatinized starch blue (abs. of free iodine).

7.73 Gm. of the Syrup should require for complete precipitation, 50 C.c. of the volumetric solution of nitrate of silver (corresponding to 10 per cent. of ferrous iodide).

SYRUPUS FERRI QUININÆ ET STRYCHNINÆ PHOSPHATUM. *U.S.*

Syrup of the Phosphates of Iron, Quinine, and Strychnine.

	By measure.
Phosphate of Iron, 133 parts, or	400 grains.
Quinine, 133 parts, or	400 grains.
Strychnine, 4 parts, or	12 grains.
Phosphoric Acid, 800 parts, or	4 fl. oz.
Sugar, in coarse powder, 6000 parts, or	42 oz. av.
Distilled Water, a sufficient quantity,	
To make 10,000 parts, or . . . about	3 pints.

Add the Phosphate of Iron to *twenty-five hundred parts* [or 1 pint] of Distilled Water, in a tared bottle large enough to hold the finished Syrup, and agitate frequently until the salt is dissolved. Having added the Phosphoric Acid to the solution, triturate the Quinine and Strychnine gradually with the mixture, in a mortar, until they are dissolved, then return the solution to the bottle and add enough Distilled Water to make the liquid weigh *four thousand parts* [or measure 24 fl. oz.]. Lastly, add the Sugar, dissolve it by agitation, without heat, and filter through paper.

Keep the Syrup in small, well-stopped vials, in a cool and dark place.

SYRUPUS HYPOPHOSPHITUM. *U.S.* **Syrup of Hypophosphites.**

	By measure.
Hypophosphite of Calcium, 35 parts, or	720 grains.
Hypophosphite of Sodium, 12 parts, or	240 grains.
Hypophosphite of Potassium, 12 parts, or	240 grains.
Citric Acid, 1 part, or	20 grains.
Spirit of Lemon, 2 parts, or	50 minims.
Sugar, in coarse powder, 500 parts, or	24 oz. av.
Water, a sufficient quantity,	
To make 1000 parts, or . . . about	2 pints.

Mix the Hypophosphites, and dissolve them, by trituration, in *three hundred and fifty parts* [or 1 pint] of Water. Should there be a trifling residue undissolved, allow the solution to settle, pour off nearly all of it, and add the Citric Acid so that the residue may be dissolved. Then, having mixed the liquids, add the Spirit of Lemon, and filter through paper, adding through the filter enough Water to make the whole weigh *five hundred parts* [or measure 21 fl. oz.]. In this liquid dissolve the Sugar, by agitation, without heat, and strain.

Keep the Syrup in well-stopped bottles.

SYRUPUS HYPOPHOSPHITUM CUM FERRO. *U.S.* **Syrup of Hypophosphites with Iron.**

	By measure.
Lactate of Iron, 1 part, or	96 grains.
Syrup of Hypophosphites, 99 parts, or	1 pint.
To make 100 parts, or	1 pint.

Dissolve the Lactate of Iron in the Syrup by trituration.

Keep the Syrup in well-stopped bottles.

SYRUPUS IPECACUANHÆ. *U.S.* **Syrup of Ipecac.**

	By measure.
Fluid Extract of Ipecac, 5 parts, or	2 fl. oz.
Syrup, 95 parts, or	29 fl. oz.
To make 100 parts, or . . . about	2 pints.

Mix them.

SYRUPUS KRAMERIÆ. *U.S.* **Syrup of Krameria.**

	By measure.
Fluid Extract of Krameria, 35 parts, or	12 fl. oz.
Syrup, 65 parts, or	20 fl. oz.
To make 100 parts, or	2 pints.

Mix them.

SYRUPUS LACTUCARII. *U.S.* **Syrup of Lactucarium.**

	By measure.
Fluid Extract of Lactucarium, 5 parts, or	2 fl. oz.
Syrup, 95 parts, or	29 fl. oz.
To make 100 parts, or . . . about	2 pints.

Mix them.

SYRUPUS LIMONIS. *U.S.* Syrup of Lemon.

	By measure.
Lemon Juice, recently expressed and strained, 40 parts, or	17 fl. oz.
Fresh Lemon Peel, 2 parts, or	1 oz. av.
Sugar, in coarse powder, 60 parts, or	28 oz. av.
Water, a sufficient quantity,	
To make 100 parts, or about	2 pints.

Heat the Lemon Juice to the boiling point; then add the Lemon Peel, and let the whole stand, closely covered, until cold. Filter, add enough Water through the filter to make the filtrate weigh *forty parts* [or measure 17 fl. oz.], dissolve the Sugar in the filtered liquid by agitation, without heat, and strain.

SYRUPUS PICIS LIQUIDÆ. *U.S.* Syrup of Tar.

	By measure.
Tar, 6 parts, or	3 oz. av.
Cold Water, 12 parts, or	5 fl. oz.
Boiling Distilled Water, 50 parts, or	20 fl. oz.
Sugar, in coarse powder, 60 parts, or	28 oz. av.
To make 100 parts, or about	2 pints.

Upon the Tar, contained in a suitable vessel, pour the cold Water, and stir the mixture frequently during twenty-four hours; then pour off the Water and throw it away. Pour the Boiling Distilled Water upon the residue, stir the mixture briskly for fifteen minutes, and set it aside for thirty-six hours, stirring occasionally. Decant the solution and filter. Lastly, in *forty parts* [or 17 fl. oz.] of the filtered solution dissolve the Sugar by agitation, without heat.

SYRUPUS PRUNI VIRGINIANÆ. *U.S.* Syrup of Wild Cherry.

	By measure.
Wild Cherry, in No. 20 powder, 12 parts, or	5½ oz. av.
Sugar, in coarse powder, 60 parts, or	28 oz. av.
Glycerin, 5 parts, or	2 fl. oz.
Water, a sufficient quantity,	
To make 100 parts, or about	2 pints.

Moisten the Wild Cherry thoroughly with Water, and macerate for twenty-four hours in a close vessel; then pack it firmly in a cylindrical glass percolator, and gradually pour Water upon it until *thirty-five parts* [or 15 fl. oz.] of percolate are obtained. Dissolve the Sugar in the liquid, by agitation, without heat, add the Glycerin, and strain.

SYRUPUS RHEI. *U.S.* Syrup of Rhubarb.

	By measure.
Rhubarb, sliced, 90 parts, or	4 oz. av.
Cinnamon, bruised, 18 parts, or	360 grains.
Carbonate of Potassium, 6 parts, or	120 grains.
Sugar, in coarse powder, 600 parts, or	28 oz. av.
Water, a sufficient quantity,	
To make 1000 parts, or about	2 pints.

Mix the Rhubarb, Cinnamon, and Carbonate of Potassium with *four hundred and twenty parts* [or 20 fl. oz.] of Water, and macerate the mixture in a glass or porcelain vessel for twelve hours. Then strain and filter, adding through the dregs, if necessary, enough Water to make the filtered liquid weigh *four hundred parts* [or measure 17 fl. oz.]. Lastly, add the Sugar, dissolve it by agitation, without heat, and strain.

SYRUPUS RHEI AROMATICUS. *U.S.* **Aromatic Syrup of Rhubarb.**

	By measure.
Aromatic Tincture of Rhubarb, 10 parts, or	2 fl. oz.
Syrup, 90 parts, or	14 fl. oz.
To make 100 parts, or	1 pint.

Mix the Aromatic Tincture of Rhubarb with the Syrup.

SYRUPUS ROSÆ. *U.S.* **Syrup of Rose.**

	By measure.
Fluid Extract of Rose, 10 parts, or	2 fl. oz.
Syrup, 90 parts, or	14 fl. oz.
To make 100 parts, or	1 pint.

Mix them.

SYRUPUS RUBI. *U.S.* **Syrup of Rubus.**

	By measure.
Fluid Extract of Rubus, 20 parts, or	4 fl. oz.
Syrup, 80 parts, or	12 fl. oz.
To make 100 parts, or	1 pint.

Mix them.

SYRUPUS RUBI IDÆI. *U.S.* **Syrup of Raspberry.**

Fresh Ripe Raspberries, any convenient quantity.
Sugar, a sufficient quantity.

Reduce the Raspberries to a pulp, and let it stand at rest for three days. Separate the juice by pressing, and set it aside until it has completely fermented and become clear, and then filter. To *forty parts* [or 1 pint] of the filtered liquid add *sixty parts* [or 25 oz. av.] of Sugar, heat to boiling, avoiding the use of tinned vessels, and strain.

Keep the Syrup in well-stopped bottles, in a cool and dark place.

SYRUPUS SARSAPARILLÆ COMPOSITUS. *U.S.* **Compound Syrup of Sarsaparilla.**

	By measure.
Sarsaparilla, in No. 30 powder, 150 parts, or	12½ oz. av.
Guaiacum Wood, in No. 30 powder, 20 parts, or	1½ oz. av.
Pale Rose, in No. 30 powder, 12 parts, or	1 oz. av.
Glycyrrhiza, in No. 30 powder, 12 parts, or	1 oz. av.
Senna, in No. 30 powder, 12 parts, or	1 oz. av.
Sassafras, in No. 20 powder, 6 parts, or	½ oz. av.
Anise, in No. 20 powder, 6 parts, or	½ oz. av.
Gaultheria, in No. 20 powder, 6 parts, or	½ oz. av.
Sugar, in coarse powder, 600 parts, or	50 oz. av.
Diluted Alcohol,	
Water, each, a sufficient quantity,	
To make 1000 parts, or	3½ pints.

Mix the solid ingredients, except the Sugar, with *three hundred parts* [or 1¼ pints] of Diluted Alcohol, and macerate the mixture for forty-eight hours; then transfer it to a cylindrical percolator, pack it firmly, and gradually pour Diluted Alcohol upon it until *six hundred parts* [or 3 pints] of tincture have been obtained. Evaporate this portion, by means of a water-bath, to *three hundred parts* [or 1¼ pints], add *one hundred parts* [or ¼ pint] of Water, and filter, adding enough Water, through the filter, to make the whole weigh *four hundred parts* [or measure 2 pints]. Lastly, add the Sugar, dissolve it by agitation, without heat, and strain.

SYRUPUS SCILLÆ. *U.S.* **Syrup of Squill.**

	By measure.
Vinegar of Squill, 40 parts, or	1 pint.
Sugar, in coarse powder, 60 parts, or	26 oz. av.
Water, a sufficient quantity,	
To make 100 parts, or	2 pints.

Heat the Vinegar of Squill to the boiling point, in a glass or porcelain vessel, and filter while hot, adding, through the filter, enough Water to make the filtrate weigh *forty parts* [or 1 pint]. Add the Sugar, dissolve it by agitation, without heat, and strain.

SYRUPUS SCILLÆ COMPOSITUS. *U.S.* **Compound Syrup of Squill.**

	By measure.
Squill, in No. 30 powder, 120 parts, or	2½ oz. av.
Senega, in No. 30 powder, 120 parts, or	2½ oz. av.
Tartrate of Antimony and Potassium, 3 parts, or	28 grains.
Sugar, in coarse powder, 1200 parts, or	26 oz. av.
Precipitated Phosphate of Calcium, 9 parts, or	90 grains.
Diluted Alcohol,	
Water, each, a sufficient quantity,	
To make 2000 parts, or . . . . . about	2 pints.

Mix the Squill and Senega, and, having moistened the mixture with *three hundred parts* [or ½ pint] of Diluted Alcohol, macerate for one hour; then transfer the mixture to a conical percolator, and gradually pour upon it Diluted Alcohol, until *nine hundred parts* [or 1½ pints] of tincture are obtained. Boil this portion for a few minutes, and then evaporate it, by means of a water-bath, to *three hundred and sixty parts* [or ½ pint]; having added *one hundred and fifty parts* [or 3 fl. oz.] of boiling Water, triturate the mixture with the Precipitated Phosphate of Calcium, filter, and add, through the filter, enough warm Water to make the whole weigh *seven hundred and fifty parts* [or measure 1 pint]. In this dissolve the Sugar, by agitation, without heat, and strain. Lastly, dissolve the Tartrate of Antimony and Potassium in *forty-seven parts* [or 1 fl. oz.] of hot Water, and mix the solution thoroughly with the Syrup.

SYRUPUS SENEGÆ. *U.S.* **Syrup of Senega.**

	By measure.
Fluid Extract of Senega, 160 parts, or	½ pint.
Water of Ammonia, 4 parts, or	1½ fl. dr.
Sugar, in coarse powder, 600 parts, or	28 oz. av.
Water, a sufficient quantity,	
To make 1000 parts, or . . . . . about	2 pints.

Mix the Fluid Extract with *two hundred and fifty parts* [or 11 fl. oz.] of Water, add the Water of Ammonia, shake the mixture well, and let it stand for a few hours; then filter through paper, adding, through the filter, enough water to make the whole weigh *four hundred parts* [or measure 18 fl. oz.]. To the filtered solution add the Sugar, dissolve it by agitation, without heat, and strain.

SYRUPUS SENNÆ. *U. S.* Syrup of Senna.

	By measure.
Senna, bruised, 33 parts, or	16 oz. av.
Sugar, in coarse powder, 60 parts, or	29 oz. av.
Alcohol, 4 parts, or	2 fl. oz.
Oil of Coriander,	
Water, each, a sufficient quantity,	
To make 100 parts, or . . . . . about	2 pints.

Digest the Senna in *one hundred and sixty parts* [or 5 pints] of Water, at a temperature not exceeding 50° C. (122° F.), for twenty-four hours, express and strain the liquid. Digest the mass with *seventy parts* [or 2 pints] of Water, at the same temperature, for six hours, and again express and strain. Mix the strained liquids, and evaporate the mixture to *thirty parts* [or 15 fl. oz.]. When cold, add the Alcohol, previously mixed with *one per cent.* [or 8 minims] of Oil of Coriander, and filter through paper, adding, through the filter, enough Water to make the whole weigh *forty parts* [or measure 18 fl. oz.]. Then add the Sugar, dissolve it by agitation, without heat, and strain.

SYRUPUS TOLUTANUS. *U. S.* Syrup of Tolu.

	By measure.
Balsam of Tolu, 4 parts, or	1½ oz. av.
Sugar, in coarse powder, 65 parts, or	28 oz. av.
Distilled Water, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the Sugar with *thirty-five parts* [or 13 fl. oz.] of Distilled Water, add the Balsam, and digest the whole in a covered vessel, at a temperature not exceeding 82° C. (180° F.), for two hours. When cold, strain through a well-wetted muslin strainer, adding, through the strainer, enough Water to make the Syrup weigh *one hundred parts* [or measure 2 pints], and mix thoroughly.

SYRUPUS ZINGIBERIS. *U. S.* Syrup of Ginger.

	By measure.
Fluid Extract of Ginger, 2 parts, or	1 fl. oz.
Sugar, in coarse powder, 65 parts, or	30 oz. av.
Water, a sufficient quantity,	
To make 100 parts, or . . . . . about	2 pints.

Rub the Fluid Extract of Ginger with *twenty-five parts* [or 12 oz. av.] of Sugar, and expose the mixture to a heat not exceeding 60° C. (140° F.), until all the alcohol has evaporated. Then mix the residue thoroughly, by agitation, with *thirty-five parts* [or 15 fl. oz.] of Water, and filter the liquid, adding, through the filter, enough Water to make the whole weigh *sixty parts* [or measure 22 fl. oz.]. Finally, add the remainder of the Sugar, dissolve it by agitation, without heat, and strain.

Mellita. *Honeys.*

Officinal honeys are thick liquid preparations closely allied to the syrups, differing merely in the use of honey as a base, instead of syrup. Their advantages over syrups are not very apparent, particularly since of late years the difficulty of obtaining pure honey has greatly increased. Three honeys are officinal.

Officinal Honeys.

Name.	Proportions and definition.	Preparation.
Mel.	Commercial Honey.	A saccharine secretion deposited in the honeycomb by Apis mellifica.
Mel Despumatum.	Clarified Honey.	Heat Honey, by means of a water-bath, remove the scum and strain.
Mel Rosæ.	8 p. Red Rose, No. 40 powder, 92 p. Clarified Honey, sufficient diluted alcohol.	Percolate Powdered Red Rose with diluted alcohol, reserving the first 3 parts of percolate; evaporate the remainder to 5 parts, add the reserved portion, and mix the whole with the Clarified Honey.

MEL DESPUMATUM. *U. S.* Clarified Honey.

Honey, a convenient quantity.

Heat the Honey, by means of a water-bath, remove the scum and strain.

MEL ROSÆ. *U. S.* Honey of Rose.

	Definite formula.
Red Rose, in No. 40 powder, 8 parts, or	2 oz. av.
Clarified Honey, 92 parts, or	23 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or about	22 fl. oz.

Moisten the powder with *two parts* [or half a fluidounce] of Diluted Alcohol, pack it firmly in a conical glass percolator, and gradually pour Diluted Alcohol upon it until *thirty-three parts* [or 8 fl. oz.] of percolate are obtained. Reserve the first *three parts* [or 6 fl. dr.] of the percolate, evaporate the remainder, by means of a water-bath, to *five parts* [or 10 fl. dr.], add the reserved portion, and mix the whole with the Clarified Honey.

Mucilagines. *Mucilages.*

The officinal mucilages are thick, viscid, adhesive liquids, produced by dissolving gum in water, or by extracting with water the mucilaginous principles from vegetable substances. There are five officinal mucilages. *Three* are made without the application of heat, and *two* with heat. The mucilages are all prone to decomposition, and should never be made in larger quantities than can be used at once.

Officinal Mucilages.

Name.	Proportions.		Process.
Mucilago Acaciæ.	34 p. Acacia; Water sufficient to make 100 p.	Without heat.	Wash the acacia with cold water, then add to it 66 parts of water; agitate until dissolved, and strain.
Mucilago Cydonii.	2 p. Cydonium; Distilled Water to make 100 p.	Without heat.	Macerate for half an hour, strain without pressure. (Will not keep.)
Mucilago Sassafras Medullæ.	2 p. Sassafras Pith; Water to make 100 p.	Without heat.	Macerate for 3 hours, and strain.
Mucilago Tragacanthæ.	6 p. Tragacanth; 18 p. Glycerin; Water sufficient to make 100 p.	With heat.	Mix the glycerin with 76 p. water, heat to boiling, add the tragacanth, macerate for 24 hours with stirring. Then add enough water to make the mixture weigh 100 p.; strain forcibly through muslin.
Mucilago Ulmi.	6 p. Elm; *Boiling* Water 100 p.	With heat.	Macerate for two hours, and strain.

MUCILAGO ACACIÆ. *U. S.* **Mucilage of Acacia.**

	By measure.
Acacia, in small fragments, 34 parts, or	4 oz. av.
Water, a sufficient quantity,	
To make 100 parts, or . . . about	9 fl. oz.

Wash the Acacia with cold Water, then add to it *sixty-six parts* [or 7½ fl. oz.] of Water, agitate occasionally until it is dissolved, and strain.

MUCILAGO CYDONII. *U. S.* **Mucilage of Cydonium.**

	By measure.
Cydonium, 2 parts, or	36 grains.
Distilled Water, 100 parts, or	4 fl. oz.

Macerate the Cydonium for half an hour, in a covered vessel, with the Distilled Water, frequently agitating. Then drain the liquid through muslin, without pressure.

This preparation should be freshly made, when required for use.

MUCILAGO SASSAFRAS MEDULLÆ. *U. S.* **Mucilage of Sassafras Pith.**

	By measure.
Sassafras Pith, 2 parts, or	36 grains.
Water, 100 parts, or	4 fl. oz.

Macerate for three hours and strain.

MUCILAGO TRAGACANTHÆ. *U. S.* **Mucilage of Tragacanth.**

	By measure.
Tragacanth, 6 parts, or	190 grains.
Glycerin, 18 parts, or	1 fl. oz.
Water, a sufficient quantity,	
To make 100 parts, or . . . about	8 fl. oz.

Mix the Glycerin with *seventy-six parts* [or 5½ fl. oz.] of Water, heat the mixture to boiling, add the Tragacanth, and let it macerate for

twenty-four hours, stirring occasionally. Then add enough Water to make the mixture weigh *one hundred parts* [or 7 oz. av.], beat it so as to render it of uniform consistence, and strain forcibly through muslin.

MUCILAGO ULMI. *U. S.* **Mucilage of Elm.**

	By measure.
Elm, sliced and dried, 6 parts, or	108 grains.
Boiling Water, 100 parts, or	4 fl. oz.

Macerate for two hours, in a covered vessel, and strain.

Misturæ. *Mixtures.*

Mixtures, in a properly-restricted sense, are aqueous liquid preparations intended for internal use, which contain suspended insoluble substances. The main object in introducing this class into the Pharmacopœia was to secure uniformity in the formulas of certain well-known and largely-used preparations. They are not permanent, as a rule, and it is not wise to keep them on hand any considerable length of time. They belong properly under the head of Extemporaneous Preparations. (See Mixtures, Part VI.) There are eleven officinal mixtures, one of which, mixture of acetate of iron and ammonia, is misnamed, as it does not contain any insoluble substance and is perfectly transparent. It belongs in the class of solutions.

Table of Officinal Mixtures.

Name.	Proportions.	Description.
Mistura Ammoniaci.	4 p. Ammoniac with 100 p. Water.	Simple gum-resin emulsions.
Mistura Asafœtidæ.	4 p. Asafœtida with 100 p. Water.	
Mistura Amygdalæ.	6 p. Sweet Almond; 1 p. Acacia; 3 p. Sugar, with 100 p. Water.	Simple seed emulsion.
Mistura Chloroformi.	8 p. Chloroform; 2 p. Camphor; 10 p. Fresh Yolk of Egg; 80 p. Water.	Egg emulsion.
Mistura Cretæ.	20 p. Compound Chalk Powder; 40 p. Cinnamon Water; 40 p. Water.	Mixtures containing insoluble powder in suspension.
Mistura Ferri Composita.	6 p. Sulphate of Iron; 8 p. Carbonate of Potassium; 18 p. Myrrh; 18 p. Sugar; 50 p. Spirit of Lavender; 900 p. Rose Water.	
Mistura Glycyrrhizæ Composita.	3 p. Pure Extract of Glycyrrhiza; 3 p. Sugar; 3 p. Acacia; 12 p. Camphorated Tincture of Opium; 6 p. Wine of Antimony; 3 p. Spirit of Nitrous Ether; 70 p. Water.	
Mistura Magnesiæ et Asafœtidæ.	5 p. Carbonate of Magnesium; 7 p. Tincture of Asafœtida; 1 p. Tincture of Opium; 10 p. Sugar; 77 p. Distilled Water.	
Mistura Ferri et Ammonii Acetatis.	2 p. Tincture of Chloride of Iron; 3 p. Diluted Acetic Acid; 20 p. Solution of Acetate of Ammonium; 10 p. Elixir of Orange; 15 p. Syrup; 50 p. Water.	Mixtures not containing insoluble powders in suspension.
Mistura Rhei et Sodæ.	30 p. Bicarbonate of Sodium; 30 p. Fluid Extract of Rhubarb; 30 p. Spirit of Peppermint; 910 p. Water.	
Mistura Potassii Citratis.	Fresh Lemon Juice; Bicarbonate of Potassium.	Effervescing mixture.

MISTURA AMMONIACI. *U.S.* Ammoniac Mixture.

	By measure.
Ammoniac, 4 parts, or	180 grains.
Water, 100 parts, or	10 fl. oz.

Rub the Ammoniac with the Water, gradually added, until they are thoroughly mixed, and strain.

MISTURA AMYGDALÆ. *U.S.* Almond Mixture.

	By measure.
Sweet Almond, 6 parts, or	240 grains.
Acacia, in fine powder, 1 part, or	40 grains.
Sugar, 3 parts, or	120 grains.
Distilled Water, 100 parts, or	9 fl. oz.

Having blanched the Almond, add the Acacia and Sugar, and beat them in a mortar, until they are thoroughly mixed; then rub the mixture with the Distilled Water, gradually added, and strain.

MISTURA ASAFŒTIDÆ. *U.S.* Asafetida Mixture.

	By measure.
Asafetida, 4 parts, or	180 grains.
Water, 100 parts, or	10 fl. oz.

Rub the Asafetida with the Water, gradually added, until they are thoroughly mixed, and strain.

MISTURA CHLOROFORMI. *U.S.* Chloroform Mixture.

	By measure.
Purified Chloroform, 8 parts, or	2 fl. dr.
Camphor, 2 parts, or	45 grains.
Fresh Yolk of Egg, 10 parts, or	½ fl. oz.
Water, 80 parts, or	4 fl. oz.
To make 100 parts, or about	5 fl. oz.

Rub the Yolk of Egg in a mortar, first by itself, then with the Camphor, previously dissolved in the Chloroform, and lastly, with the Water, gradually added, so as to make a uniform mixture.

MISTURA CRETÆ. *U.S.* Chalk Mixture.

	By measure.
Compound Chalk Powder, 20 parts, or	480 grains.
Cinnamon Water, 40 parts, or	2 fl. oz.
Water, 40 parts, or	2 fl. oz.
To make 100 parts, or about	4 fl. oz.

Rub the Powder with the Cinnamon Water and Water, gradually added, until they are thoroughly mixed.

This preparation should be freshly made, when wanted for use.

MISTURA FERRI COMPOSITA. *U.S.* **Compound Iron Mixture.**

[GRIFFITH'S MIXTURE.]

	By measure.
Sulphate of Iron, in coarse powder, 6 parts, or	24 grains.
Myrrh, in small pieces, 18 parts, or	72 grains.
Sugar, 18 parts, or	72 grains.
Carbonate of Potassium, 8 parts, or	32 grains.
Spirit of Lavender, 50 parts, or	½ fl. oz.
Rose Water, 900 parts, or	8 fl. oz.
To make 1000 parts, or . . . . . about	9 fl. oz.

Rub the Myrrh, Sugar, and Carbonate of Potassium with the Rose Water, gradually added; then with the Spirit of Lavender, and lastly, with the Sulphate of Iron. Pour the mixture immediately into a bottle, which should be well stopped.

This preparation should be freshly made, when wanted for use.

MISTURA FERRI ET AMMONII ACETATIS. *U.S.* **Mixture of Acetate of Iron and Ammonium.**

[BASHAM'S MIXTURE.]

	By measure.
Tincture of Chloride of Iron, 2 parts, or	1½ fl. dr.
Diluted Acetic Acid, 3 parts, or	2 fl. dr.
Solution of Acetate of Ammonium, 20 parts, or	14 fl. dr.
Elixir of Orange, 10 parts, or	6 fl. dr.
Syrup, 15 parts, or	1 fl. oz.
Water, 50 parts, or	4 fl. oz.
To make 100 parts, or . . . . . about	8 fl. oz.

To the Solution of Acetate of Ammonium, previously mixed with the Diluted Acetic Acid, add the Tincture of Chloride of Iron, and afterward the Elixir of Orange, Syrup, and Water, and mix the whole thoroughly.

MISTURA GLYCYRRHIZÆ COMPOSITA. *U.S.* **Compound Mixture of Glycyrrhiza.**

[BROWN MIXTURE.]

	By measure.
Pure Extract of Glycyrrhiza, 3 parts, or	½ oz. av.
Sugar, 3 parts, or	½ oz. av.
Acacia, in fine powder, 3 parts, or	½ oz. av.
Camphorated Tincture of Opium, 12 parts, or	2 fl. oz.
Wine of Antimony, 6 parts, or	1 fl. oz.
Spirit of Nitrous Ether, 3 parts, or	½ fl. oz.
Water, 70 parts, or	12 fl. oz.
To make 100 parts, or	1 pint.

Rub the Extract of Glycyrrhiza, Sugar, and Acacia with the Water, gradually added; then add the other ingredients, and mix the whole thoroughly.

MISTURA MAGNESIÆ ET ASAFŒTIDÆ. *U.S.* **Mixture of Magnesia and Asafetida.**

[DEWEES' CARMINATIVE.]

	By measure.
Carbonate of Magnesium, 5 parts, or	360 grains.
Tincture of Asafetida, 7 parts, or	10 fl. dr.
Tincture of Opium, 1 part, or	75 minims.
Sugar, 10 parts, or	1½ oz. av.
Distilled Water, a sufficient quantity, To make 100 parts, or	1 pint.

Rub the Carbonate of Magnesium and Sugar, in a mortar, with the Tincture of Asafetida and Tincture of Opium. Then gradually add enough Distilled Water to make the mixture weigh *one hundred parts* [or measure 1 pint].

MISTURA POTASSII CITRATIS. *U.S.* **Mixture of Citrate of Potassium.**

[NEUTRAL MIXTURE.]

	By measure.
Fresh Lemon Juice, strained, 100 parts, or	4 fl. oz.
Bicarbonate of Potassium, about 10 parts, or, a sufficient quantity	170 gr. ?

Add the Bicarbonate of Potassium gradually to the Lemon Juice until it is neutralized.

This preparation should be freshly made, when wanted for use.

MISTURA RHEI ET SODÆ. *U.S.* **Mixture of Rhubarb and Soda.**

	By measure.
Bicarbonate of Sodium, 30 parts, or	½ oz. av.
Fluid Extract of Rhubarb, 30 parts, or	3 fl. dr.
Spirit of Peppermint, 30 parts, or	5 fl. dr.
Water, a sufficient quantity, To make 1000 parts, or	1 pint.

Dissolve the Bicarbonate of Sodium in *five hundred parts* [or ½ pint] of Water. Add the Fluid Extract of Rhubarb and the Spirit of Peppermint, and lastly, enough Water to make the mixture weigh *one thousand parts* [or measure 1 pint].

Glycerita. *Glycerites.*

Glycerites are mixtures of medicinal substances with glycerin. The officinal preparations are not solutions, although formerly all of the glycerites were transparent liquids. Glycerin is a valuable solvent, one of the principal advantages of the glycerites officinal in U. S. P. 1870 being that they afforded a rapid and simple method of making aqueous solutions of substances which were not otherwise easily soluble. The solutions of carbolic acid, gallic acid, tannic acid, and tar, etc., in glycerin are permanent preparations, and they could be made very concentrated if necessary: the ease with which they can be diluted with water or alcohol, without precipitation, renders such glycerites especially useful at the prescription counter. But two glycerites are now officinal, both

are mixtures, and neither of them approaches in importance the position held by the glycerites of the U. S. Pharmacopœia, 1870.

Officinal Glycerites.

Name.	Proportion.
Glyceritum Amyli.	10 p. Starch; 90 p. Glycerin: a translucent jelly.
Glyceritum Vitelli.	45 p. Fresh Yolk of Egg; 55 p. Glycerin.

GLYCERITUM AMYLI. *U.S.* Glycerite of Starch.

	By measure.
Starch, 10 parts, or	1 oz. av.
Glycerin, 90 parts, or	7 fl. oz.
To make 100 parts, or about	8 fl. oz.

Rub them together in a mortar until they are intimately mixed. Then transfer the mixture to a porcelain capsule, and apply a heat gradually raised to 140° C. (284° F.), and not exceeding 144° C. (291° F.), stirring constantly, until the starch granules are completely dissolved, and a translucent jelly is formed.

GLYCERITUM VITELLI. *U.S.* Glycerite of Yolk of Egg.

[GLYCONIN.]

	By measure.
Fresh Yolk of Egg, 45 parts, or	13 oz. av.
Glycerin, 55 parts, or	16 oz. av.
To make 100 parts, or about	24 fl. oz.

Rub the Yolk of Egg with the Glycerin gradually added, until they are thoroughly mixed.

CHAPTER XXIII.

ALCOHOLIC SOLUTIONS.

Spiritus. *Spirits.*

SPIRITS from a pharmaceutical point of view are simply *alcoholic* solutions of volatile substances. Like the medicated waters, the active ingredient may be solid, liquid, or gaseous. None are made by percolation, but they are officinally prepared in five ways: 1. By simple solution. 2. By solution with maceration. 3. By gaseous solution. 4. By chemical reaction. 5. By distillation. The number of officinal spirits is twenty-two.

1. **By Simple Solution.**—This is the most usual method of making spirits, and of the twenty-two officinal preparations of this class fifteen, or three-fourths of the whole number, are prepared in this way, whilst ten of the fifteen are merely solutions of volatile oils in alcohol of different strengths, without any other addition. No skill is required to make these, but a great deal of conscientious care must be used in the selection of the volatile oil, that it be of the best quality and recently distilled. Filtration is usually unnecessary.

SPIRITUS. *U. S. P.*

Spirits made by Simple Solution.

Name.	Proportions.	Uses and Dose.
Spiritus Ætheris.	30 p. Stronger Ether; 70 p. Alcohol.	Stimulant, ʒi to ʒiij.
Spiritus Ætheris Compositus.	30 p. Stronger Ether; 3 p. Ethereal Oil; 67 p. Alcohol.	Anodyne, stimulant, 30 to 60♏.
Spiritus Ammoniæ Aromaticus.	4 p. Carbonate Ammonium; 10 p. Water of Ammonia; 1.2 p. Oil of Lemon; .1 p. Oil Lavender Flowers; .1 p. Oil Pimenta; 70 p. Alcohol; 15 p. Water.	Antacid, 30 to 60♏.
Spiritus Anisi.	10 p. Oil Anise; 90 p. Alcohol.	Carminative, ʒi.
Spiritus Aurantii.	6 p. Oil Orange Peel; 94 p. Alcohol.	Flavor.
Spiritus Camphoræ.	10 p. Camphor; 70 p. Alcohol; 20 p. Water.	Stimulant, 5 to 60♏.
Spiritus Chloroformi.	10 p. Purif. Chloroform; 90 p. Alcohol.	Sedative, stimulant, 10 to 60♏.
Spiritus Cinnamomi.	10 p. Oil Cinnamon; 90 p. Alcohol.	Stimulant, 5 to 15♏.
Spiritus Gaultheriæ.	3 p. Oil Gaultheria; 97 p. Alcohol.	Flavor, 5 to 15♏.
Spiritus Juniperi.	3 p. Oil Juniper; 97 p. Alcohol.	Stimulant, diuretic, ʒi to ʒij.
Spiritus Juniperi Compositus.	.2 p. Oil Juniper; .02 p. Oil Caraway; .02 p. Oil Fennel; 60 p. Alcohol; 40 p. Water.	Stimulant, diuretic, ʒij to ʒiv.

Spirits made by Simple Solution.—(*Continued.*)

Name.	Proportions.	Uses and Dose.
Spiritus Lavandulæ.	3 p. Oil Lavender Flowers; 97 p. Alcohol.	fʒss to fʒi.
Spiritus Myrciæ.	.88 p. Oil Myrcia; .05 p. Oil Orange Peel; 05 p. Oil Pimenta; 56 p. Alcohol; 44 p. Water.	Externally.
Spiritus Myristicæ.	3 p. Oil Nutmeg; 97 p. Alcohol.	fʒss to fʒi.
Spiritus Odoratus.	1.6 p. Oil Bergamot; .8 p. Oil Lemon; .8 p. Oil Rosemary; .4 p. Oil Lavender Flowers; .4 p. Oil Orange Flowers; .2 p. Acetic Ether; 15.8 p. Water; 80 p. Alcohol.	Perfume.

2. **Solution with Maceration.**—This method is employed solely in the Pharmacopœia when it is desirable to introduce the coloring-matter of the drug into the preparation. This has been done in order to bestow individuality, and in deference to popular feeling in favor of high colors. It is very doubtful whether either object is worthy of consideration.

Spirits made by Solution with Maceration.

Name.	Preparation.	Uses and Dose.
Spiritus Limonis.	6 p. Oil Lemon; 4 p. Lemon Peel, fresh; Alcohol to make 100 p.	For flavoring.
Spiritus Menthæ Piperitæ.	10 p. Oil Peppermint; 1 p. Peppermint Herb; Alcohol to make 100 p.	Carminative, 10 to 20mɱ.
Spiritus Menthæ Viridis.	10 p. Oil Spearmint; 1 p. Spearmint Herb; Alcohol to make 100 p.	Carminative, 10 to 20mɱ.

3. **By Gaseous Solution.**—The only officinal representative of this class is the spirit of ammonia, and it is the only preparation in the Pharmacopœia that is made by converting a gaseous aqueous solution into a gaseous alcoholic solution by expelling the dissolved gas from water by heat, and causing it to be redissolved in alcohol. The spirit is assayed by volumetric solution of oxalic acid, and brought to the standard strength of 10 per cent. of gaseous ammonia.

Spirit made by Gaseous Solution.

Name.	Preparation.	Use and Dose.
Spiritus Ammoniæ.	Stronger Water of Ammonia; Heat; Alcohol; 10 p.c. Gas; assay.	Stimulant, 5 to 30mɱ.

4. **By Chemical Reaction.**—There is but one spirit in the Pharmacopœia made by chemical reaction, and that is spirit of nitrous ether. As explained elsewhere (Part IV.), it is the product of the action of nitric acid upon alcohol, and is an alcoholic solution of ethyl nitrite.

Spirit made by Chemical Reaction.

Name.	Preparation.	Use and Dose.
Spiritus Ætheris Nitrosi.	5 p.c. Ethyl Nitrite.	Diaphoretic, diuretic, f℥ss to f℥i.

5. **By Distillation.**—This method of making spirits is the oldest and in many respects the best in use. When the desirable volatile principles which are present in the preparation when finished can be vaporized at the temperature of boiling alcohol or diluted alcohol, distillation is preferred. In the case of liquids containing some oils of high boiling-points, it is necessary to obtain the oils by distillation with water and afterwards mix the distillate with alcohol. It is certain, however, that spirits made by the admixture of volatile oils with alcohol, as in Class 1, are often deficient in the more delicate and volatile principles found in the substances from which they are distilled. These principles are often soluble in water and insoluble in the oil, and necessarily in the distillation of the volatile oil with water they must be found in the water, and are absent from the oil. This is well illustrated in the case of oil of neroli and orange flower water: the latter has much the more fragrant odor when compared with the oil obtained in the same distillation from the same flowers and subjected to the same temperature. The only officinal spirits made by distillation are two in number, —whisky and brandy.

Spirits made by Distillation.

Name.	Preparation.	Use and Dose.
Spiritus Frumenti.	By distillation from fermented grain; must be at least 2 years old.	Stimulant, f℥ss to f℥i.
Spiritus Vini Gallici.	By distillation from fermented grapes; must be at least 4 years old.	Stimulant, f℥ss to f℥i.

PRACTICAL PROCESSES FOR OFFICINAL SPIRITS.

SPIRITUS ÆTHERIS. *U.S.* Spirit of Ether.

	By measure.
Stronger Ether, 30 parts, or	4 fl. oz.
Alcohol, 70 parts, or	8½ fl. oz.
To make 100 parts, or	12½ fl. oz.

Mix them.

SPIRITUS ÆTHERIS COMPOSITUS. *U.S.* Compound Spirit of Ether.

[HOFFMANN'S ANODYNE.]

	By measure.
Stronger Ether, 30 parts, or	4 fl. oz.
Alcohol, 67 parts, or	8 fl. oz.
Ethereal Oil, 3 parts, or	2½ fl. dr.
To make 100 parts, or . . . about	12 fl. oz.

Mix them.

SPIRITUS ÆTHERIS NITROSI. *U.S.* Spirit of Nitrous Ether.

[SWEET SPIRIT OF NITRE.]

An alcoholic solution of Ethyl Nitrite [$C_2H_5NO_2$; 75], containing 5 per cent. of the crude Ether.

Nitric Acid, 9 parts, or	9 oz. av.
Sulphuric Acid, 7 parts, or	7 oz. av.
Alcohol,	
Distilled Water, each, a sufficient quantity.	

Add the Sulphuric Acid gradually to *thirty-one parts* [or 36 fl. oz.] of Alcohol. When the mixture has cooled, transfer it to a tubulated retort connected with a well cooled condenser, to which a receiver, surrounded by broken ice, is connected air-tight, and which is further connected, by means of a glass tube, with a small vial containing water, the end of the tube dipping into the latter. Now add the Nitric Acid to the contents of the retort, and, having introduced a thermometer through the tubulure, heat rapidly, by means of a water-bath, until strong reaction occurs and the temperature reaches 80° C. (176° F.). Continue the distillation at that temperature, and not exceeding 82° C. (180° F.), until the reaction ceases. Disconnect the receiver, and immediately pour the distillate into a flask containing *sixteen parts* [or 1 pint] of ice-cold Distilled Water. Close the flask and agitate the contents repeatedly, keeping down the temperature by immersing the flask occasionally in ice-water. Then separate the ethereal layer, and mix it immediately with *nineteen times* its weight of Alcohol.

Keep the product in small glass-stoppered vials, in a dark place, remote from lights or fire.

For comments on the process, see Spiritus Ætheris Nitrosi, Part V.

SPIRITUS AMMONIÆ. *U.S.* Spirit of Ammonia.

An alcoholic solution of Ammonia [NH_3; 17], containing 10 per cent., by weight, of the gas.

	By measure.
Stronger Water of Ammonia, 45 parts, or	8 fl. oz.
Alcohol, recently distilled, and which has been kept in glass vessels, a sufficient quantity,	
To make . . . . . about	16 fl. oz.

Pour the Stronger Water of Ammonia into a flask connected with a well cooled receiver, into which *eighty parts* [or 1 pint] of Alcohol are introduced. Heat the flask carefully, and very gradually, to a temperature not exceeding 60° C. (140° F.), and maintain it at that temperature for about ten minutes. Then disconnect the receiver, and, having ascertained the ammoniacal strength of the contents by means of the volumetric solution of oxalic acid, add enough Alcohol to make the product contain *ten per cent.* of Ammonia.

Keep the product in glass-stoppered bottles, in a cool place.

For comments on the process, see Spiritus Ammoniæ, Part IV.

SPIRITUS AMMONIÆ AROMATICUS. *U.S.* **Aromatic Spirit of Ammonia.**

	By measure.
Carbonate of Ammonium, 40 parts, or	500 grains.
Water of Ammonia, 100 parts, or	22 fl. dr.
Oil of Lemon, 12 parts, or	2½ fl. dr.
Oil of Lavender Flowers, 1 part, or	12 minims.
Oil of Pimenta, 1 part, or	10 minims.
Alcohol, recently distilled, and which has been kept in glass vessels, 700 parts, or	22 fl. oz.
Distilled Water, a sufficient quantity, To make 1000 parts, or	2 pints.

To the Water of Ammonia, contained in a flask, add *one hundred and forty parts* [or 4 fl. oz.] of Distilled Water, and afterward the Carbonate of Ammonium reduced to a moderately fine powder. Close the flask and agitate the contents until the Carbonate is dissolved. Weigh the Alcohol in a tared flask of suitable capacity, or pour twenty-two fluidounces in a bottle, add the oils, then gradually add the solution of Carbonate of Ammonium, and afterward enough Distilled Water to make the product weigh *one thousand parts* [or measure 2 pints]. Lastly, filter the liquid, through paper, in a well-covered funnel.

Keep the product in glass-stoppered bottles, in a cool place.

For comments on the process, see Spiritus Ammoniæ Aromaticus, Part IV.

SPIRITUS ANISI. *U.S.* **Spirit of Anise.**

	By measure.
Oil of Anise, 10 parts, or	1 fl. oz.
Alcohol, 90 parts, or	11 fl. oz.
To make 100 parts, or	12 fl. oz.

Mix them.

SPIRITUS AURANTII. *U.S.* **Spirit of Orange.**

	By measure.
Oil of Orange Peel, 6 parts, or	1 fl. oz.
Alcohol, 94 parts, or	16 fl. oz.
To make 100 parts, or	17 fl. oz.

Mix them.

SPIRITUS CAMPHORÆ. *U.S.* **Spirit of Camphor.**

	By measure.
Camphor, 10 parts, or	3 oz. av.
Alcohol, 70 parts, or	25 fl. oz.
Water, 20 parts, or	6 fl. oz.
To make 100 parts, or about	2 pints.

Dissolve the Camphor in the Alcohol, add the Water, and filter through paper.

SPIRITUS CHLOROFORMI. *U.S.* **Spirit of Chloroform.**

	By measure.
Purified Chloroform, 10 parts, or	1 fl. oz.
Alcohol, 90 parts, or	16 fl. oz.
To make 100 parts, or	17 fl. oz.

Mix them.

SPIRITUS CINNAMOMI. *U.S.* Spirit of Cinnamon.

	By measure.
Oil of Cinnamon, 10 parts, or	1 fl. oz.
Alcohol, 90 parts, or	12 fl. oz.
To make 100 parts, or	13 fl. oz.

Mix them.

SPIRITUS FRUMENTI. *U.S.* Whisky.

An alcoholic liquid, obtained by the distillation of fermented grain (usually corn, wheat, or rye), and at least two years old.

SPIRITUS GAULTHERIÆ. *U.S.* Spirit of Gaultheria.

	By measure.
Oil of Gaultheria, 3 parts, or	160 minims.
Alcohol, 97 parts, or	16 fl. oz.
To make 100 parts, or about	1 pint.

Mix them.

SPIRITUS JUNIPERI. *U.S.* Spirit of Juniper.

	By measure.
Oil of Juniper, 3 parts, or	224 minims.
Alcohol, 97 parts, or	16 fl. oz.
To make 100 parts, or about	1 pint.

Mix them.

SPIRITUS JUNIPERI COMPOSITUS. *U.S.* Compound Spirit of Juniper.

	By measure.
Oil of Juniper, 10 parts, or	20 minims.
Oil of Caraway, 1 part, or	2 minims.
Oil of Fennel, 1 part, or	2 minims.
Alcohol, 3000 parts, or	16 fl. oz.
Water, a sufficient quantity,	
To make 5000 parts, or about	1½ pints.

Dissolve the Oils in the Alcohol, and gradually add enough Water to make the product weigh *five thousand parts* [or measure 1½ pints].

SPIRITUS LAVANDULÆ. *U.S.* Spirit of Lavender.

	By measure.
Oil of Lavender Flowers, 3 parts, or	4 fl. dr.
Alcohol, 97 parts, or	16 fl. oz.
To make 100 parts, or about	1 pint.

Mix them.

SPIRITUS LIMONIS. *U.S.* Spirit of Lemon.

[Essence of Lemon.]

	By measure.
Oil of Lemon, 6 parts, or	1 fl. oz.
Lemon Peel, freshly grated, 4 parts, or	240 grains.
Alcohol, a sufficient quantity,	
To make 100 parts, or	1 pint.

Dissolve the Oil of Lemon in *ninety parts* [or 14 fl. oz.] of Alcohol, add the Lemon Peel, and macerate for twenty-four hours; then filter

through paper, adding through the filter enough Alcohol to make the Spirit weigh *one hundred parts* [or measure 1 pint].

SPIRITUS MENTHÆ PIPERITÆ. *U.S.* Spirit of Peppermint.

[Essence of Peppermint.]

	By measure.
Oil of Peppermint, 10 parts, or	11 fl. dr.
Peppermint, in coarse powder, 1 part, or	40 grains.
Alcohol, a sufficient quantity,	
To make 100 parts, or	1 pint.

Dissolve the Oil of Peppermint in *ninety parts* [or 14 fl. oz.] of Alcohol, add the Peppermint, and macerate for twenty-four hours; then filter through paper, adding through the filter enough Alcohol to make the Spirit weigh *one hundred parts* [or measure 1 pint].

SPIRITUS MENTHÆ VIRIDIS. *U.S.* Spirit of Spearmint.

[Essence of Spearmint.]

	By measure.
Oil of Spearmint, 10 parts, or	11 fl. dr.
Spearmint, in coarse powder, 1 part, or	40 grains.
Alcohol, a sufficient quantity,	
To make 100 parts, or	1 pint.

Dissolve the Oil of Spearmint in *ninety parts* [or 14 fl. oz.] of Alcohol, add the Spearmint, and macerate for twenty-four hours; then filter through paper, adding through the filter enough Alcohol to make the Spirit weigh *one hundred parts* [or measure 1 pint].

SPIRITUS MYRCIÆ. *U.S.* Spirit of Myrcia.

[Bay Rum.]

	By measure.
Oil of Myrcia, 16 parts, or	1 fl. oz.
Oil of Orange Peel, 1 part, or	40 minims.
Oil of Pimenta, 1 part, or	25 minims.
Alcohol, 1000 parts, or	4½ pints.
Water, 782 parts, or	3½ pints.
To make 1800 parts, or about	8 pints.

Mix the Oils with the Alcohol, and gradually add the Water to the solution. Set the mixture aside, in a well-stopped bottle, for eight days, then filter through paper, in a well-covered funnel.

SPIRITUS MYRISTICÆ. *U.S.* Spirit of Nutmeg.

[Essence of Nutmeg.]

	By measure.
Oil of Nutmeg, 3 parts, or	4 fl. dr.
Alcohol, 97 parts, or	1 pint.
To make 100 parts, or about	1 pint.

Mix them.

SPIRITUS ODORATUS. *U.S.* Perfumed Spirit.

[COLOGNE WATER.]

	By measure.
Oil of Bergamot, 16 parts, or	2 fl. oz.
Oil of Lemon, 8 parts, or	1 fl. oz.
Oil of Rosemary, 8 parts, or	1 fl. oz.
Oil of Lavender Flowers, 4 parts, or	½ fl. oz.
Oil of Orange Flowers, 4 parts, or	½ fl. oz.
Acetic Ether, 2 parts, or	2 fl. dr.
Water, 158 parts, or	18 fl. oz.
Alcohol, 800 parts, or	6½ pints.
To make 1000 parts, or . . . about	8 pints.

Dissolve the Oils and the Acetic Ether in the Alcohol, and add the Water. Set the mixture aside, in a well-closed bottle, for eight days, then filter through paper, in a well-covered funnel.

SPIRITUS VINI GALLICI. *U.S.* Brandy.

An alcoholic liquid obtained by the distillation of fermented grapes, and at least four years old.

For comments upon Spiritus Vini Gallici, see Part V.

Elixiria. *Elixirs.*

Elixirs are aromatic, sweetened, spirituous preparations containing small quantities of active medicinal substances. Although they are largely employed throughout the United States, but one has been made officinal,—*i.e.*, the elixir of orange. This is intended as a vehicle for the administration of active remedies in small doses. There will be found in the Appendix a number of formulas of unofficinal elixirs.

PRACTICAL PROCESS FOR OFFICINAL ELIXIR.

ELIXIR AURANTII. *U.S.* Elixir of Orange.

[SIMPLE ELIXIR.]

	By measure.
Oil of Orange Peel, 1 part, or	2½ fl. dr.
Cotton, 2 parts, or	4 dr.
Sugar, in coarse powder, 100 parts, or	25 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 300 parts, or . . . about	4 pints.

Mix Alcohol and Water in the proportion of *one part* [or 1 pint] of Alcohol to *three parts* [or 2¼ pints] of Water. Add the Oil of Orange Peel to the Cotton, in small portions at a time, distributing it thoroughly by picking the Cotton apart after each addition; then pack tightly in a conical percolator, and gradually pour on the mixture of Alcohol and Water, until *two hundred parts* [or 3¼ pints] of filtered liquid are obtained. In this liquid dissolve the Sugar by agitation, without heat, and strain.

CHAPTER XXIV.

ETHEREAL SOLUTIONS.

Collodia. *Collodions.*

COLLODIONS are liquid preparations intended for external use, having for the base a solution of pyroxylin, or gun-cotton, in a mixture of ether and alcohol. (For a description of the properties of pyroxylin and collodions, see Part V.) Collodions are applied to the skin by means of a soft brush, and when the ether and alcohol evaporate a film is left on the surface, which either acts as a protection or brings a medicating agent in contact with the epidermis. Four collodions are officinal.

Officinal Collodions.

Name.	Proportions.
Collodium.	4 p. Pyroxylin; 70 p. Stronger Ether; 26 p. Alcohol. Decant the clear collodion from the sediment.
Collodium cum Cantharide.	60 p. Cantharides, No. 60 Powder; 85 p. Flexible Collodion; Commercial Chloroform sufficient to exhaust the cantharides; after distillation the residue should weigh 15 parts. Decant the clear cantharidal collodion from the sediment.
Collodium Flexile.	92 p. Collodion; 5 p. Canada Turpentine; 3 p. Castor Oil.
Collodium Stypticum.	20 p. Tannic Acid; 5 p. Alcohol; 20 p. Stronger Ether; 55 p. Collodion.

COLLODIUM. *U.S.* **Collodion.**

	By measure.
Pyroxylin, 4 parts, or	½ oz. av.
Stronger Ether, 70 parts, or	11 fl. oz. 5 fl. dr.
Alcohol, 26 parts, or	3 fl. oz. 7 fl. dr.
To make 100 parts, or . . . about	1 pint.[1]

To the Pyroxylin, contained in a tared bottle, add the Alcohol and let it stand for fifteen minutes; then add the Ether, and shake the mixture until the Pyroxylin is dissolved. Cork the bottle well and set it aside until the liquid has become clear. Then decant it from any sediment which may have formed, and transfer it to bottles, which should be securely corked.

Keep the Collodion in a cool place, remote from lights or fire.

[1] End-product varies with the amount of deposit.

COLLODIUM CUM CANTHARIDE. *U. S.* Collodion with Cantharides.

[CANTHARIDAL COLLODION.]

	By measure.
Cantharides, in No. 60 powder, 60 parts, or	10 oz. av.
Flexible Collodion, 85 parts, or	14 oz. av.
Commercial Chloroform, a sufficient quantity,	
To make 100 parts, or . . . . . about	1 pint.[1]

Pack the powder firmly in a cylindrical percolator, and gradually pour Commercial Chloroform upon it, until *two hundred and fifty parts* [or 28 fl. oz.] of tincture are obtained, or until the Cantharides are exhausted. Recover, by distillation on a water-bath, about *two hundred parts* [or 23 fl. oz.] of the Chloroform, and evaporate the residue in a capsule, by means of a water-bath, until it weighs *fifteen parts* [or measures 14 fl. dr.]. Dissolve this in the Flexible Collodion, and let it stand at rest for forty-eight hours. Finally, pour off the clear portion from any sediment which may have been deposited, and transfer it to bottles, which should be securely corked.

Keep the Cantharidal Collodion in a cool place, remote from lights or fire.

COLLODIUM FLEXILE. *U. S.* Flexible Collodion.

	By measure.
Collodion, 92 parts, or	12 oz. av.
Canada Turpentine, 5 parts, or	285 grains.
Castor Oil, 3 parts, or	170 grains.
To make 100 parts, or . . . . . about	1 pint.

Mix them and keep the mixture in a well-corked bottle, in a cool place, remote from lights or fire.

COLLODIUM STYPTICUM. *U. S.* Styptic Collodion.

	By measure.
Tannic Acid, 20 parts, or	80 grains.
Alcohol, 5 parts, or	26 minims.
Stronger Ether, 20 parts, or	110 minims.
Collodion, 55 parts, or	4½ fl. dr.
To make 100 parts, or . . . . . about	1 fl. oz.

Place the Tannic Acid in a tared bottle, add the Alcohol, Ether, and Collodion, and agitate until the Tannic Acid is dissolved.

Keep the product in well-corked bottles, in a cool place, remote from lights or fire.

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[1] End-product varies with the amount of deposit.

CHAPTER XXV.

OLEAGINOUS SOLUTIONS OR EXTERNAL APPLICATIONS.

Linimenta. *Liniments.*

THESE are solutions of various substances or mixtures in oily or alcoholic liquids containing fatty oils, intended for external application, and usually applied with friction and rubbing of the skin. There are ten officinal liniments, four of which are made with cotton seed oil as the base, four with alcohol as the principal liquid, and two contain oil of turpentine. They are classified as follows:

Officinal Liniments.

Name.	Base.	Proportions.
Linimentum Ammoniæ.	Oil.	30 p. Water of Ammonia; 70 p. Cotton Seed Oil.
Linimentum Calcis.	Oil.	50 p. Solution of Lime; 50 p. Cotton Seed Oil.
Linimentum Camphoræ.	Oil.	20 p. Camphor; 80 p. Cotton Seed Oil.
Linimentum Plumbi Subacetatis.	Oil.	40 p. Solution of Subacetate of Lead; 60 p. Cotton Seed Oil.
Linimentum Belladonnæ.	Alcohol.	5 p. Camphor; 95 p. Fluid Extract of Belladonna.
Linimentum Chloroformi.	Alcohol.	40 p. Commercial Chloroform; 60 p. Soap Liniment.
Linimentum Saponis.	Alcohol.	10 p. Soap; 5 p. Camphor; 1 p. Oil of Rosemary; 70 p. Alcohol; 14 p. Water.
Linimentum Sinapis Compositum.	Alcohol.	3 p. Volatile Oil of Mustard; 2 p. Extract of Mezereum; 6 p. Camphor; 15 p. Castor Oil; 74 p. Alcohol.
Linimentum Cantharidis.	Oil of Turpentine.	15 p. Cantharides; 85 p. Oil of Turpentine.
Linimentum Terebinthinæ.	Oil of Turpentine.	65 p. Resin Cerate; 35 p. Oil of Turpentine.

PRACTICAL PROCESSES FOR OFFICINAL LINIMENTS.

LINIMENTUM AMMONIÆ. *U.S.* Ammonia Liniment.

Water of Ammonia, 30 parts, or	4½ oz. av.
Cotton Seed Oil, 70 parts, or	10½ oz. av.
To make 100 parts, or	15 oz. av.

Mix them.

LINIMENTUM BELLADONNÆ. *U.S.* **Belladonna Liniment.**

	By measure.
Fluid Extract of Belladonna, 95 parts, or	19 fl. oz.
Camphor, 5 parts, or	1 oz. av.
To make 100 parts, or about	20 fl. oz.

Dissolve the Camphor in the Fluid Extract.

LINIMENTUM CALCIS. *U.S.* **Lime Liniment.**

Solution of Lime, 50 parts, or	8 oz. av.
Cotton Seed Oil, 50 parts, or	8 oz. av.
To make 100 parts, or about	1 pint.

Mix them.

LINIMENTUM CAMPHORÆ. *U.S.* **Camphor Liniment.**

Camphor, 20 parts, or	3 oz. av.
Cotton Seed Oil, 80 parts, or	12 oz. av.
To make 100 parts, or	15 oz. av.

Dissolve the Camphor in the Oil.

LINIMENTUM CANTHARIDIS. *U.S.* **Cantharides Liniment.**

	By measure.
Cantharides, in No. 60 powder, 15 parts, or	1 oz. av.
Oil of Turpentine, a sufficient quantity, or	8 fl. oz.
To make 100 parts, or	½ pint.

Digest the Cantharides with *one hundred parts* [or ½ pint] of Oil of Turpentine, in a closed vessel, by means of a water-bath, for three hours; then strain and add enough Oil of Turpentine through the strainer to make the Liniment weigh *one hundred parts* [or measure ½ pint].

LINIMENTUM CHLOROFORMI. *U.S.* **Chloroform Liniment.**

	By measure.
Commercial Chloroform, 40 parts, or	4 fl. oz.
Soap Liniment, 60 parts, or	11 fl. oz.
To make 100 parts, or	15 fl. oz.

Mix them.

LINIMENTUM PLUMBI SUBACETATIS. *U.S.* **Liniment of Subacetate of Lead.**

Solution of Subacetate of Lead, 40 parts, or	2 oz. av.
Cotton Seed Oil, 60 parts, or	3 oz. av.
To make 100 parts, or	5 oz. av.

Mix them.

LINIMENTUM SAPONIS. *U.S.* **Soap Liniment.**

	By measure.
Soap, in shavings, 10 parts, or	5 oz. av.
Camphor, 5 parts, or	2½ oz. av.
Oil of Rosemary, 1 part, or	4½ fl. dr.
Alcohol, 70 parts, or	41 fl. oz.
Water, a sufficient quantity,	
To make 100 parts, or	3½ pints.

Digest the Soap in *fourteen parts* [or 7 fl. oz.] of Water, until it is dissolved; dissolve the Camphor and Oil in the Alcohol; mix the solutions, and filter through paper, adding enough Water, through the filter, to make the Liniment weigh *one hundred parts* [or measure 3½ pints].

LINIMENTUM SINAPIS COMPOSITUM. *U.S.* **Compound Liniment of Mustard.**

	By measure.
Volatile Oil of Mustard, 3 parts, or	1 fl. dr.
Extract of Mezereum, 2 parts, or	40 grains.
Camphor, 6 parts, or	120 grains.
Castor Oil, 15 parts, or	6 fl. dr.
Alcohol, a sufficient quantity,	
To make 100 parts, or	5¼ fl. oz.

Dissolve the Extract of Mezereum and the Camphor in *seventy parts* [or 4 fl. oz.] of Alcohol; then add the Oil of Mustard and the Castor Oil and, finally, enough Alcohol to make the product weigh *one hundred parts* [or measure 5½ fl. oz.].

LINIMENTUM TEREBINTHINÆ. *U.S.* **Turpentine Liniment.**

	By measure.
Resin Cerate, 65 parts, or	13 oz. av.
Oil of Turpentine, 35 parts, or	½ pint.
To make 100 parts, or	20 oz. av.

Add the Oil to the Cerate previously melted, and mix them thoroughly.

Oleata. *Oleates.*

The officinal oleates are liquid preparations made by dissolving metallic salts or alkaloids in oleic acid. The term oleate is also used commercially to designate solid preparations, which are supposed to be chemical compounds of oleic acid with various bases. (See Part V.) The officinal oleates are not assumed to be definite chemical compounds. The proportion of oleic acid is very excessive, and they must be regarded as solutions of the medicating agent in oleic acid, the latter having special advantages as a basis for administering external remedies, being more readily absorbed than most of the fatty substances used in making ointments. Two oleates are officinal.

Officinal Oleates.

Name.	Proportions.
Oleatum Hydrargyri.	10 p. Yellow Oxide of Mercury to 90 p. Oleic Acid.
Oleatum Veratrinæ.	2 p. Veratrine to 98 p. Oleic Acid.

OLEATUM HYDRARGYRI. *U. S.* Oleate of Mercury.

	By measure.
Yellow Oxide of Mercury, thoroughly dried, 10 parts, or	40 grains.
Oleic Acid, 90 parts, or about	1 fl. oz.
To make 100 parts, or	1 fl. oz.

Heat the Oleic Acid, contained in a porcelain vessel, to near 74° C. (165.2° F.), taking care not to exceed this temperature. Gradually add the Oxide of Mercury, and stir until it is dissolved.

OLEATUM VERATRINÆ. *U. S.* Oleate of Veratrine.

	By measure.
Veratrine, 2 parts, or	8 grains.
Oleic Acid, 98 parts, or	1 fl. oz.
To make 100 parts, or	1 fl. oz.

Rub the Veratrine with a small quantity of the Oleic Acid, in a warm mortar, to a smooth paste. Add this to the remainder of the Oleic Acid, heated in a porcelain capsule, on a water-bath, and stir until it is dissolved.

CHAPTER XXVI.

AQUEOUS LIQUIDS MADE BY PERCOLATION OR MACERATION.

Infusa. *Infusions.*

INFUSIONS are liquid preparations made by treating vegetable substances with either hot or cold water. *The drug is not subjected to the boiling process,* although it is common to pour boiling water over it; the whole is allowed to stand in a close vessel until cold. Whilst the use of hot water has the advantage of saving time in some cases, it is often objectionable because the *inert* principles in the drug are dissolved by the hot water, and as the infusion cools, they are precipitated out in such a very finely divided condition that they cannot be readily separated by colation or filtration. Cold water should be selected as the menstruum when the drug contains a valuable volatile principle, when the active agent is injured by heat, or when the desirable principles are readily soluble in water of ordinary temperature. The time required to make the infusion must be considered, for in warm weather it is quite possible for an infusion to ferment or decompose before it is finished.

Pure water should be used in making infusions, and large quantities should not be made at one time unless demanded for immediate use, as, without special precautions to preserve them, they soon become decomposed.

Of the inert principles found in plants, starch is extracted by hot water and albumen by cold water, whilst gum, sugar, and extractive are dissolved by both.

In making infusions the drug is usually coarsely comminuted, sliced, or bruised. Fine powders should be avoided whenever possible, because it is difficult to separate the fine particles from the infusion; and if percolation is resorted to, so much time is consumed in the operation, owing to the swelling of the powder, that decomposition may set in before the preparation is finished. The number of officinal infusions is *five.* Infusions are usually made in four ways: 1. By maceration. 2. By digestion. 3. By percolation. 4. By diluting fluid extracts.

1. **By Maceration.**—This is the process which is most frequently used. The general formula of the U.S. Pharmacopœia, which is here appended, furnishes a model.

GENERAL OFFICINAL FORMULA FOR INFUSIONS.

An ordinary Infusion, the strength of which is not directed by the physician, nor specified by the Pharmacopœia, shall be prepared by the following formula:

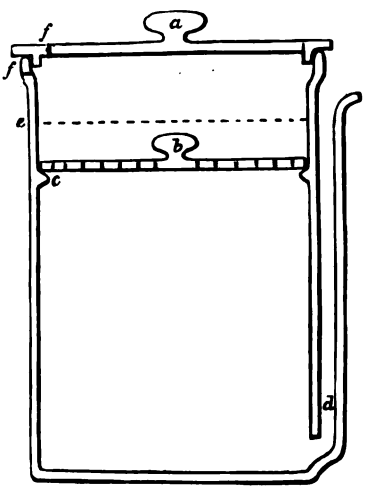
Take of	By measure.
The Substance, coarsely comminuted, 10 parts, or	1 oz. av.
Boiling Water, 100 parts, or	10 fl. oz.
Water, a sufficient quantity,	
To make 100 parts, or	10 fl. oz.

Put the substance into a suitable vessel, provided with a cover, pour upon it the Boiling Water, cover the vessel tightly, and let it stand two hours. Then strain, and pass enough Water through the strainer to make the Infusion weigh *one hundred parts*, or measure 10 fluid-ounces.[1]

Caution.—The strength of Infusions of energetic or powerful substances should be specially prescribed by the physician.

It will be found most convenient to provide special apparatus for making infusions by maceration. One of the oldest forms is known as *Alsop's Infusion Jar.* This presents a very neat and effectual method of making the hot infusions. It consists of an earthen-ware mug, represented in Fig. 320, with a spout, *d*, proceeding from the bottom, and placed closely to the side of the vessel to prevent fracture; a perforated plate or diaphragm, *b*, supported on a ledge, *c*, at about one-quarter or one-third of the height of the vessel from the top; and a lid, *a*, which may be fastened on by a string through holes *f f*. The material to be submitted to infusion is placed on the perforated plate, and the hot water poured in so as to cover it, the vessel having been previously warmed, so as not to chill the liquid. As the water becomes impregnated, it acquires an increased specific gravity, and sinks to the bottom, its place being supplied by the unsaturated portion; and this circulation goes on until the whole of the soluble matter is extracted. In order to maintain a due warmth, the vessel may be placed upon a stove, or upon an iron plate near the fire. The advantage of the process is that the material is subjected to the solvent power of the least impregnated portion of the menstruum. In order that the vessel may be adapted for the preparation of different quantities of infusions, it would be an advantage to have ledges arranged within, at different heights, so that the diaphragm may be supported at any desired point. The surface of the liquid, *e*, should of course always be above the medicinal substance placed upon the diaphragm.

FIG. 320.

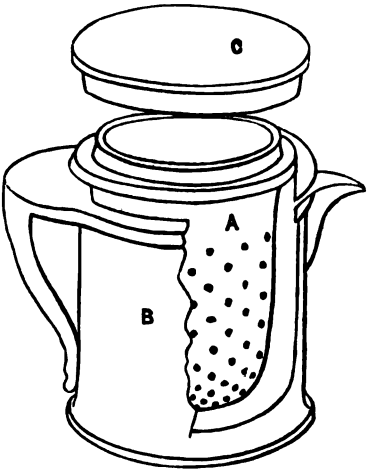


Alsop's infusion jar.

[1] The average difference between the relation by weight and that by measure is 5 per cent. For the sake of simplicity, this has been disregarded, as the drugs themselves often vary this much in the amount of moisture present, and the dosage varies even more widely.

Squire's Infusion Mug differs from the preceding in having a colander of queen's-ware, which is closely covered with a lid, and descends into the jar so as to form a diaphragm for the support of the substance to be infused. It has the advantage that the material, after having been exhausted, may be lifted out without disturbing the infusion. Fig. 321 shows the mug. It is made of queen's-ware, of the capacity of one pint, B: into it a thimble-shaped colander, A, descends, supported on the rim of the mug by a projecting ledge, with a carefully-fitted cover, C, which closes the whole. The substance to be submitted to infusion is introduced into the colander either before or after it has been fitted to the mug; the water, hot or cold, as the case may be, is then poured in so as to fill the lower vessel and cover the materials in the upper; and, the cover having been applied, the vessel is set aside for the length of time required. The colander is then to be lifted out, and the infusion, without having to strain it, is ready for use.

Fig. 321.



Squire's infusion mug.

Fig. 322.

Infusion pitcher.

Fig. 323.

Infusion mug (home-made).

Fig. 322 represents an earthen-ware infusion pitcher, which may be used for making a gallon of infusion: it is useful where there is a large demand. Its principle of action is similar to that of Squire's infusion mug. A still better and cheaper apparatus may be made by the pharmacist himself, by selecting a queen's-ware or porcelain tea- or coffee-pot, A, as in Fig. 323, and if a hole is bored with the broken end of a small file through the top, close to the handle, a copper wire may be passed through the hole and around the handle, and made to terminate in a hook. The material to be infused is loosely tied up in a square piece of cheese-cloth (coarse, thin muslin) and suspended from the hook: the hot water soon penetrates all parts of the drug and dissolves out the soluble principles by circulatory displacement. This method has the great advantage that no further straining is needed, as the bag retains all of the solid undissolved portion; this may be pressed and the contents thrown away.

Officinal Infusions made by Maceration.

Name.	Proportion.	Use and Dose.
Infusum Brayeræ.	6 p.c. Koosso; Boiling Water; *not to be strained.*	Tænicide, f℥viij.
Infusum Digitalis.	1½ p.c. Digitalis; 1½ p.c. Cinnamon; 7½ p.c. Alcohol; Boiling Water.	Diuretic, etc., f℥iv.
Infusum Sennæ Compositum.	6 p.c. Senna; 12 p.c. Manna; 12 p.c. Sulph. Magnesium; 2 p.c. Fennel; Boiling Water.	Purgative, f℥ij to f℥iv.

2. **By Digestion.**—The process of *digestion* consists in subjecting the substance to the continued action of moderate heat below the boiling temperature. In making infusions digestion is often very useful, although it may not be directed in the formula. It generally suffices to place the infusion vessel (see Fig. 323) upon a moderately hot portion of the stove-plate, or upon the floor near the stove or source of heat.

3. **By Percolation.**—This method of making infusions is by far the most satisfactory, and should be used whenever possible. It should be selected when the desirable principles are easily dissolved in water, and when the amount of menstruum is amply sufficient to exhaust the drug thoroughly. Percolation presents the advantages of furnishing a finished preparation, straining being unnecessary. Again, precipitation from the deposition of inert principles after the infusion has been strained, due to the principles being soluble in hot water but insoluble in cold water, is avoided. The chief drawback to the adoption of percolation in making infusions is the length of time it takes to exhaust the drug with water. Infusions are generally extemporaneous preparations, and they are frequently desired quickly: hence the process of maceration is often selected in preference.

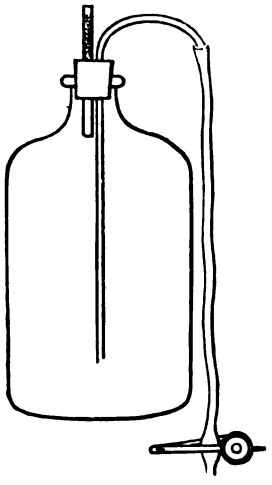
Officinal Infusions made by Percolation.

Name.	Proportion.	Use.
Infusum Cinchonæ.	6 p.c. Cinchona; 1 p.c. Aromatic Sulphuric Acid and Water.	Tonic.
Infusum Pruni Virginianæ.	4 p.c. Wild-Cherry Bark; Water.	Tonic.

Preservation of Infusions.—The difficulty in preserving infusions arises from the decomposition of the principles which are extracted by water and retained in the preparation. If sufficient alcohol is added to prevent decomposition, the therapeutic action of the infusion is usually interfered with, owing to the comparatively large proportion of spirit contained in the dose. Alcohol is successfully used in preparations like infusion of gentian, orange peel, etc., or simple tonics. If an antiseptic, like boric, carbolic, or salicylic acid, is used, the same objection exists,—the interference due to the therapeutic action of the antiseptic.

It has been proved that infusions may be preserved for a long time if they are protected from the microscopic organisms which float in the air. A simple method is to heat the infusion contained in the bottle gradually to the boiling-point, in order to destroy any of the spores that may be present, and then to transfer it at once to small bottles, which are filled to the brim, the corks forced in and tied over, and the cork, lip, and neck of each bottle dipped into hot sealing-wax. A useful modification of Almen's method consists in heating to the boiling-point the infusion contained in a bottle in a water-bath. The rubber cork of the bottle is perforated so as to admit a long bent tube and a short tube; the short tube is loosely filled with cotton, the long limb of the bent tube is passed through the cork, and a rubber tube with a pinch-cock attached, as shown in Fig. 324. The cotton permits the admission of air into the bottle, but excludes spores and dust. The infusion may be drawn as wanted from the bottle by the rubber tube and syphon, the flow being controlled by the pinch-cock and started by suction.

FIG. 824.



Infusion bottle.

Infusions from Fluid Extracts.—The habit of making infusions from concentrated alcoholic tinctures or fluid extracts is improper and unjustifiable, except in those few cases in which the active and desirable principles of the drug are equally soluble in alcohol and in water, or in the menstrua used for both fluid extract and infusion. This is well illustrated in those preparations in which the activity of the drug is due to resinous bodies. Alcoholic menstrua here are necessary to dissolve the resins, and if such a fluid extract is added to water, precipitation takes place and the filtered infusion is worthless. If the precipitate is inert or does not carry down with it any portion of the active principle, and is readily separated, the only objection to the infusion is the presence of the alcohol, which may or may not seriously interfere with the therapeutic action, according as the quantity present is large or small. The saving in time and labor by making infusions in this way is the cause of the frequent employment of this method, but it should never be used if the therapeutic action of the drug is weakened thereby. The substitution of a fluid extract infusion in a prescription for one directed to be made by the officinal process is very reprehensible.

PRACTICAL PROCESSES FOR OFFICINAL INFUSIONS.

INFUSA. Infusions.

General Officinal Formula.—An ordinary infusion, the strength of which is not directed by the physician, nor specified by the Pharmacopœia, shall be prepared by the following formula:

Take of	By measure.
The Substance, coarsely comminuted, 10 parts, or	1 oz. av.
Boiling Water, 100 parts, or	10 fl. oz.
Water, a sufficient quantity,	
To make 100 parts, or	10 fl. oz.

Put the substance into a suitable vessel, provided with a cover, pour upon it the Boiling Water, cover the vessel tightly, and let it stand two hours. Then strain, and pass enough Water through the strainer to make the Infusion weigh *one hundred parts* [or measure 10 fl. oz.].

Caution.—The strength of infusions of energetic or powerful substances should be specially prescribed by the physician.

INFUSUM BRAYERA. *U.S.* Infusion of Brayera.

	By measure.
Brayera, in No. 20 powder, 6 parts, or	1 oz. av.
Boiling Water, 100 parts, or	1 pint.

Pour the Boiling Water upon the Brayera, and let it macerate in a covered vessel until cool.

This Infusion should be dispensed without straining.

INFUSUM CINCHONÆ. *U.S.* Infusion of Cinchona.

	By measure.
Cinchona, in No. 40 powder, 6 parts, or	1 oz. av.
Aromatic Sulphuric Acid, 1 part, or	72 minims.
Water, a sufficient quantity,	
To make 100 parts, or	1 pint.

Mix the Acid with *fifty parts* [or ½ pint] of Water, and moisten the powder with *three parts* [or ½ fl. oz.] of the mixture; pack it firmly in a conical glass percolator, and gradually pour upon it, first, the remainder of the mixture, and afterward, Water, until the Infusion weighs *one hundred parts* [or measures 1 pint].

When no variety of Cinchona is specified by the physician directing this Infusion, use Yellow Cinchona.

INFUSUM DIGITALIS. *U.S.* Infusion of Digitalis.

	By measure.
Digitalis, in No. 20 powder, 3 parts, or	55 grains.
Cinnamon, in No. 20 powder, 3 parts, or	55 grains.
Boiling Water, 185 parts, or	7½ fl. oz.
Alcohol, 15 parts, or	6½ fl. dr.
Water, a sufficient quantity,	
To make 200 parts or	8 fl. oz.

Pour the Boiling Water upon the mixed powders, and macerate for two hours in a covered vessel. Then strain, add the Alcohol, and pass enough Water through the strainer to make the Infusion weigh *two hundred parts* [or measure 8 fl. oz.].

INFUSUM PRUNI VIRGINIANÆ. *U.S.* **Infusion of Wild Cherry.**

	By measure.
Wild Cherry, in No. 40 powder, 4 parts, or	1 oz. av.
Water, a sufficient quantity,	
To make 100 parts, or	24 fl. oz.

Moisten the powder with *six parts* [or 12 fl. dr.] of Water, and macerate for one hour; then pack it firmly in a conical glass percolator, and gradually pour Water upon it until the Infusion weighs *one hundred parts* [or measures 24 fl. oz.].

INFUSUM SENNÆ COMPOSITUM. *U.S.* **Compound Infusion of Senna.**

[BLACK DRAUGHT.]

	By measure.
Senna, 6 parts, or	½ oz. av.
Manna, 12 parts, or	1 oz. av.
Sulphate of Magnesium, 12 parts, or	1 oz. av.
Fennel, bruised, 2 parts, or	73 grains.
Boiling Water, 100 parts, or	8 fl. oz.
Water, a sufficient quantity,	
To make 100 parts, or	8 fl. oz.

Pour the Boiling Water upon the solid ingredients and macerate in a covered vessel until cool. Then strain, and add enough Water through the strainer to make the Infusion weigh *one hundred parts* [or measure 8 fl. oz.].

UNOFFICINAL INFUSIONS.

INFUSUM GENTIANÆ COMPOSITUM. *U.S.P.* 1870. **Compound Infusion of Gentian.**

	By measure.
Gentian, in moderately coarse powder	½ troy oz.
Bitter Orange Peel, in moderately coarse powder	60 grains.
Coriander, in moderately coarse powder	60 grains.
Alcohol	2 fl. oz.
Water, a sufficient quantity.	

Mix the Alcohol with fourteen fluidounces of Water, and, having moistened the mixed powders with three fluidrachms of the menstruum, pack them firmly in a conical percolator, and gradually pour upon them first the remainder of the menstruum, and afterwards Water, until the filtered liquid measures a pint.

INFUSUM GENTIANÆ COMPOSITUM FORTIUS. Concentrated Compound Infusion of Gentian (quadruple strength).

Gentian, in moderately coarse powder	2 troy oz.
Bitter Orange Peel, in moderately coarse powder	½ troy oz.
Coriander, in moderately coarse powder	½ troy oz.
Alcohol	2 fl. oz.
Water	14 fl. oz.

Mix the Alcohol with the Water, and, having moistened the mixed powders with one fluidounce of the menstruum, pack them firmly in a conical percolator, and gradually pour upon them first the remainder of the menstruum, and afterwards Water, until the filtered liquid measures a pint. This preparation keeps well, is four times the strength of the U.S.P. 1870 infusion, and may be diluted with Water containing Alcohol in the same proportion (1 Alcohol, 7 Water) when Compound Infusion of Gentian is prescribed. If water alone is used to dilute it, a precipitate is apt to occur.

INFUSUM ROSÆ COMPOSITUM. *U.S.* 1870. **Compound Infusion of Rose.**

Red Rose (dried petals)	½ troy oz.
Diluted Sulphuric Acid	3 fl. dr.
Sugar (in coarse powder)	1½ troy oz.
Boiling Water	2½ pints.

Pour the Water upon the Rose, in a covered glass or porcelain vessel; add the Acid, and macerate for half an hour. Lastly, dissolve the Sugar in the liquid, and strain.

INFUSUM SALVIÆ. *U.S.* 1870. **Infusion of Sage.**

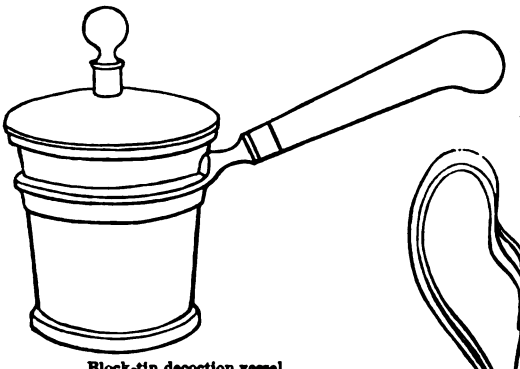
Sage	½ troy oz.
Boiling Water	1 pint.

Macerate for half an hour in a covered vessel, and strain.

Decocta. *Decoctions.*

Decoctions are liquid preparations made by *boiling* vegetable substances with water. The object sought to be gained in preparing decoctions is to secure the soluble active principles of drugs which are not injured by heat in aqueous solution. It is obvious that very few drugs are suited to this form of administration; and decoctions are rapidly declining in favor. Hot infusion will generally afford a means of obtaining all the benefits that are derived from boiling the drug with water, whilst the prolonged action of boiling water generally exercises a dissociating effect upon the active principles. The disadvantages

FIG. 325.



Block-tin decoction vessel.

FIG. 326.

Brass water-bath.

of hot infusions are possessed in a more marked degree by decoctions (see page 290). In compound decoctions the ingredients are preferably added at different periods of the operation, the hard, ligneous drugs being added first, and the aromatics, or those containing volatile oils, at the close of the process, so that loss of activity of the latter may not ensue.

The earthen-ware or porcelain vessels used in preparing infusions are preferred for decoctions (see page 292), as they will bear the heat of boiling water, if heated gradually. Fig. 325 shows a block-tin vessel employed for preparing decoctions, used largely in Germany, and to some extent here. It is preferably used in connection with the brass water-bath, R (see Fig. 326). The rim, F, is somewhat flexible, whilst a small aperture permits the escape of steam. The empyreumatic odor which many decoctions possess when made over a naked fire, and caused by particles adhering to the bottom of the vessel and becoming charred, is avoided by the use of the water-bath.

Iron vessels are not used advantageously, because of the discoloration which is caused by the tannin of astringent drugs reacting with the iron.

The number of officinal decoctions is *two*.

PRACTICAL PROCESSES FOR OFFICINAL DECOCTIONS.

DECOCTA. Decoctions.

General Officinal Formula.—An ordinary Decoction, the strength of which is not directed by the physician, nor specified by the Pharmacopœia, shall be prepared by the following formula:

Take of	By measure.
The Substance, coarsely comminuted, 10 parts, or	1 oz. av.
Water, a sufficient quantity,	
To make 100 parts, or	10 fl. oz.

Put the substance into a suitable vessel, provided with a cover, pour upon it *one hundred parts* [or 10 fl. oz.] of cold Water, cover it well, and boil for fifteen minutes; then let it cool to about 45° C. (113° F.), strain the liquid, and pass through the strainer enough cold Water to make the product weigh *one hundred parts* [or measure 10 fl. oz.].

Caution.—The strength of Decoctions of energetic or powerful substances should be specially prescribed by the physician.

DECOCTUM CETRARIÆ. *U.S.* Decoction of Cetraria.

	By measure.
Cetraria, 5 parts, or	1 oz. av.
Water, a sufficient quantity,	
To make 100 parts, or	20 fl. oz.

Cover the Cetraria, in a suitable vessel, with *forty parts* [or 8 fl. oz.] of cold Water, express after half an hour, and throw away the liquid. Then boil the Cetraria with *one hundred parts* [or 20 fl. oz.] of Water for half an hour, strain, and add enough cold Water, through the strainer, to make the product weigh *one hundred parts* [or measure 20 fl. oz.].

DECOCTUM SARSAPARILLÆ COMPOSITUM. *U.S.* Compound Decoction of Sarsaparilla.

	By measure.
Sarsaparilla, cut and bruised, 10 parts, or	720 grains.
Sassafras, in No. 20 powder, 2 parts, or	144 grains.
Guaiacum Wood, rasped, 2 parts, or	144 grains.
Glycyrrhiza, bruised, 2 parts, or	144 grains.
Mezereum, cut and bruised, 1 part, or	72 grains.
Water, a sufficient quantity,	
To make 100 parts, or	1 pint.

Boil the Sarsaparilla and Guaiacum Wood for half an hour in a suitable vessel with *one hundred parts* [or 1 pint] of Water; then add the Sassafras, Glycyrrhiza, and Mezereum, cover the vessel well, and macerate for two hours; finally strain, and add enough cold Water, through the strainer, to make the product weigh *one hundred parts* [or measure 1 pint].

UNOFFICINAL DECOCTIONS.

DECOCTUM SARSAPARILLÆ COMPOSITUM FORTIUS. *P. G.*

Zittmann's Decoction (Stronger).

	By measure.
Sarsaparilla, cut, 100 parts, or	2 oz. av.
Water, 2600 parts, or	50 fl. oz.

Digest for twenty-four hours and, having added

Sugar, 5 parts, or	44 grains,
Alum, 5 parts, or	44 grains,

expose them in a covered vessel, with occasional stirring, for three hours, to the heat of boiling water; then add to the mixture

Anise, bruised, 5 parts, or	44 grains.
Fennel, bruised, 5 parts, or	44 grains.
Senna, cut, 25 parts, or	½ oz. av.
Liquorice Root, cut, 10 parts, or	88 grains.

Digest for a quarter of an hour, and strain the liquid with expression. Allow the Decoction to settle; then pour off the liquid, and, by the addition of water, bring it to *two thousand five hundred parts* [or 3 pints].

DECOCTUM SARSAPARILLÆ COMPOSITUM MITIUS. *P. G.*

Zittmann's Decoction (Milder).

	By measure.
Sarsaparilla, cut, 50 parts, or	1 oz. av.
Water, 2400 parts, or	46 fl. oz.

Digest for twenty-four hours, and expose in a covered vessel, with occasional stirring, for three hours, to the heat of boiling water on a water-bath. Then add to the decoction:

Lemon Peel, cut, 5 parts, or	44 grains.
Cinnamon, bruised, 5 parts, or	44 grains.
Cardamom, bruised, 5 parts, or	44 grains.
Liquorice Root, cut, 5 parts, or	44 grains.

Digest for a quarter of an hour, and strain the liquid with expression. Allow the Decoction to settle; then pour off the liquid, and, by the addition of water, bring it to *two thousand five hundred parts* [or 3 pints].

CHAPTER XXVII.

ALCOHOLIC LIQUIDS MADE BY PERCOLATION OR MACERATION.

Tincturæ. *Tinctures.*

TINCTURES are alcoholic solutions of medicinal substances. They differ from spirits in being made from *non-volatile* bodies, there being but one officinal exception to this rule.[1] They are made by percolation, maceration, solution, or dilution, and the menstrua employed in the officinal tinctures are alcohol, diluted alcohol of various strengths, aromatic spirit of ammonia, or mixtures of alcohol, water, and glycerin. The officinal tinctures are *seventy-three* in number. In some unofficinal tinctures, ether, spirit of ether, ammoniated alcohol, and spirit of nitrous ether are used. The use of alcohol as a solvent for the active or useful principles in drugs has been practised for many years, but it has required a long time and much experience to determine the proper proportion of water to dilute the alcohol so that the menstrua should thoroughly exhaust the drugs without extracting the inert principles, and yet contain sufficient alcohol to secure permanent preparations that will not deposit in time a portion of their active constituents. The advantages of alcohol as a menstruum have been proved so thoroughly, that the use of aqueous preparations has greatly declined in this country; and yet there are some instances, particularly in the case of the weak tinctures and those requiring a large dose, in which the therapeutic action of the menstruum almost equals that of the drug. In these cases, however, the physician may prefer the fluid extract when he does not desire the stimulating action of the alcohol in the tincture.

In selecting the menstrua the proportion of water in each case was made as great as possible without endangering the permanency of the preparation, one especial advantage being that such tinctures may be added in small proportions to aqueous preparations without serious precipitation. In this respect tinctures have usually a great advantage over fluid extracts, and weaker alcoholic menstrua are often used successfully for tinctures when such would be entirely unsuitable for fluid extracts, because the tincture, on account of its comparative weakness, having a much larger proportion of menstruum to exhaust the drug with, than the fluid extract, may have the excess over the proportion of alcohol used in the fluid extract made up with water. It has been proved that a pint of diluted alcohol will extract by percolation a larger proportion of the soluble principles of a drug than half a pint of alcohol and half a pint of water percolated separately through the drug.

[1] Tincture of Iodine.

The properties of *alcohol* are considered under another head (Part IV.), yet it seems desirable to notice here the solvent properties of this valuable preservative. It mixes freely with water, ether, acetic acid, a number of volatile oils, and castor oil; it dissolves resins, camphor, tannin, benzoic acid, chlorophyl, the alkaloids, balsams, iodine, ferric chloride, ammonium carbonate, etc. *Diluted alcohol* extracts from drugs, gum, extractive, chlorophyl, albumen, coloring matter, resins, volatile oils, alkaloids, sugar, tannin, etc. *Glycerin* is used in tinctures to prevent precipitation by retaining in solution principles which would otherwise in time be deposited.

Preparation.—Tinctures are officinally made in three ways: 1. By percolation. 2. By maceration. 3. By solution or dilution.

1. **By Percolation.**—This is the best method for making tinctures, and it is always directed by the Pharmacopœia when practicable. Tinctures are made in this way from all drugs which are capable of being readily comminuted and displaced. The special advantages of percolation over maceration and expression are seen in the saving of time and labor, and in the greater efficiency of the product if the process has been carefully and skilfully performed. In working practically from the officinal formulas, it will be found that the use of the alternative measure formula will be very much more convenient than the use of parts by weight, as the frequent weighings necessary to bring the end-product to the exact weight, in the case of the tinctures made by percolation, will prove to be an annoyance which few practical operators will care to endure. If the drugs from which the tinctures are directed to be made could be standardized so that they would always contain a definite and uniform weight of the active principles, there might be an advantage in bringing the end-product to a weight which would bear a simple relation to the proportion of active principles selected as a standard; but the Pharmacopœia, for obvious reasons, has not fixed a limit for even the amount of moisture in air-dried drugs, and to assay all of them and fix a maximum and minimum limit of each active principle present in each drug would be impracticable, and in most cases impossible. Now, the variation in the amount of moisture and in the proportion of active principles in commercial drugs is far greater than is generally supposed; and so long as this ever-present bar to uniformity is not overcome, it is useless to regard here the trifling advantage supposed to exist in favor of accuracy and convenience in weighing liquids: practically, the accuracy resolves itself into a question of personal error, for a careful operator will make more accurate tinctures by using measures than a careless one will by using weights, and *vice versa*. Fifty-four officinal tinctures, or more than two-thirds of the whole number, are made by percolation.

2. **By Maceration.**—This method of making tinctures is officinally used in the case of resins, balsams, gums, soap, etc., where the practical difficulties likely to be encountered in percolation would offset any advantages that the latter process might possess (see page 217).

3. **By Solution or Dilution.**—A few tinctures are made in this way, such as tincture of iodine by dissolving iodine in alcohol, tincture of chloride of iron by diluting the solution of ferric chloride with alcohol.

The following tables exhibit the officinal tinctures, classified so as to show their relative strength both as to weight and volume, the variations in menstrua, and other useful data:

Table of Officinal Tinctures arranged in the Order of their Relative Strength, with other Data.

Total Percentage by Weight of Drugs or Active Agents.	Number of Grains of Active Ingredients in a Fluidrachm.	Officinal Name.	Fineness of Powder.	Menstruum.	Ingredients in 100 Parts by Weight.
1.6	½ grain Powd. Opium.	Tinctura Opii Camphorata.	50	Dil. Alcohol.	.4 Powd. Opium; .4 Benzoic Acid; .4 Oil of Anise; .4 Camphor; 4 p. Glycerin.
		Cantharidis.	60	Alcohol.	5 p. Cantharides.
		Capsici.	30	95 p. Alcohol; 5 p. Water.	5 p. Capsicum.
5	2½	Lavandulæ Composita.	20	68 p. Alcohol; 27 p. Water.	.8 p. Oil Lavender; .2 p. Oil Rosemary; 1.8 p. Cinnamon; .4 p. Cloves; 1 p. Nutmeg; .8 p. Red Saunders.
5.5	. . .	Cardamomi Composita.	40	Dil. Alcohol; 6 p.c. Glyc.	2 p. Cardamom; 2 p. Cinnamon; 1 p. Caraway; .5 p. Cochineal.
8	4	Iodi.	. .	Alcohol.	8 p. Iodine.
		Bryoniæ.	40	Alcohol.	10 p. Bryonia.
10	4½	Physostigmatis.	40	Alcohol.	10 p. Physostigma.
		Sumbul.	30	Alcohol.	10 p. Sumbul.
		Tolutana.	. .	Alcohol.	10 p. Balsam of Tolu.
		Arnicæ Radicis.	40	Dil. Alcohol.	10 p. Arnica Root.
		Chiratæ.	40	Dil. Alcohol.	10 p. Chirata.
		Croci.	. .	Dil. Alcohol.	10 p. Saffron.
		Cubebæ.	30	Dil. Alcohol.	10 p. Cubeb.
		Matico.	40	Dil. Alcohol.	10 p. Matico.
10	5½	Moschi.	. .	Dil. Alcohol.	10 p. Musk.
		Quassiæ.	40	Dil. Alcohol.	10 p. Quassia.
		Serpentariæ.	40	Dil. Alcohol.	10 p. Serpentaria.
		Stramonii.	40	Dil. Alcohol.	10 p. Stramonium Seed.
		Vanillæ.	Bruised.	Alc. 2; Wat. 1.	10 p. Vanilla.
		Calumbæ.	20	Alc. 3; Wat. 2.	10 p. Calumba.
		Cinnamomi.	40	Alc. 3; Wat. 2.	10 p. Cinnamon.
	½ gr. Ext.	Ignatiæ.	60	Alc. 8; Wat. 1.	10 p. Ignatia.
		Opii.	50	Dil. Alcohol.	10 p. Powdered Opium.
	5½	Opii Deodorata.	50	Alc. 2; Wat. 8.	10 p. Powdered Opium.
		Kino.	. .	Alc. 60; Glyc. 15; Wat. 15.	10 p. Kino.
		Gentianæ Composita.	40	Dil. Alcohol.	8 p. Gentian; 4 p. Bitter Orange Peel; 2 p. Cardamom.
14	7½	Rhei.	40	Dil. Alcohol.	12 p. Rhubarb; 2 p. Cardamom.
		Gelsemii.	60	Alcohol.	15 p. Gelsemium.
		Belladonnæ.	60	Dil. Alcohol.	15 p. Belladonna Leaves.
		Cardamomi.	30	Dil. Alcohol.	15 p. Cardamom.
		Colchici.	30	Dil. Alcohol.	15 p. Colchicum Seed.
		Conii.	30	Dil. Alcohol.	15 p. Conium; .4 p.c. Dil. HCl.
15	8½	Digitalis.	60	Dil. Alcohol.	15 p. Digitalis.
		Hyoscyami.	60	Dil. Alcohol.	15 p. Hyoscyamus.
		Scillæ.	30	Dil. Alcohol.	15 p. Squill.
		Sanguinariæ.	60	Alc. 2; Wat. 1.	15 p. Sanguinaria.

Table of Tinctures, U. S. P.—(*Continued.*)

Total Percentage by Weight of Drugs or Active Agents.	Number of Grains of Active Ingredients in a Fluidrachm.	Officinal Name.	Fineness of Powder.	Menstruum.	Ingredients in 100 Parts by Weight.
17	9	Tinctura Rhei Dulcis.	40	Dil. Alcohol.	8 p. Rhubarb; 4 p. Glycyrrhiza; 4 p. Anise; 1 p. Cardamom.
		Aloes et Myrrhæ.	50	Alcohol.	10 p. Aloes; 10 p. Myrrh.
		Asafœtidæ.	Bruised.	Alcohol.	20 p. Asafetida.
		Aurantii Dulcis.	Cut.	Alcohol.	20 p. Sweet Orange Peel.
		Benzoini.	40	Alcohol.	20 p. Benzoin.
		Cannabis Indicæ.	40	Alcohol.	20 p. Indian Cannabis.
20	10¼	Cimicifugæ.	60	Alcohol.	20 p. Cimicifuga.
		Guaiaci.	20	Alcohol.	20 p. Guaiac.
		Myrrhæ.	20	Alcohol.	20 p. Myrrh.
		Pyrethri.	40	Alcohol.	20 p. Pyrethrum.
		Zingiberis.	40	Alcohol.	20 p. Ginger.
		Aloes.	50	Dil. Alcohol.	10 p. Aloes; 10 p. Extract Glycyrrhiza.
		Arnicæ Florum.	20	Dil. Alcohol.	20 p. Arnica Flowers.
		Aurantii Amari.	30	Dil. Alcohol.	20 p. Bitter Orange Peel.
		Calendulæ.	20	Dil. Alcohol.	20 p. Calendula.
		Catechu Compositæ.	40	Dil. Alcohol.	12 p. Catechu; 8 p. Cinnamon.
		Gallæ.	40	Dil. Alcohol; 10 p.c. Glyc.	20 p. Nutgall.
		Humuli.	20	Dil. Alcohol.	20 p. Hops.
		Hydrastis.	60	Dil. Alcohol.	20 p. Hydrastis.
		Ipecacuanhæ et Opii.	. .	Dil. Alcohol.	10 p. Fluid Extract Ipecacuanha; Deod. Tinct. Opium to 100 parts.
20	10¼	Krameriæ.	40	Dil. Alcohol.	20 p. Krameria.
		Lobeliæ.	40	Dil. Alcohol.	20 p. Lobelia.
		Nucis Vomicæ.	60	Alc. 8; Wat. 1.	20 p. Nux Vomica.
		Valerianæ.	60	Alc. 2; Wat. 1.	20 p. Valerian.
		Cinchonæ.	60	Alc. 65; Wat. 25; Glyc. 10.	20 p. Yellow Cinchona.
		Cinchonæ Compositæ.	60	Alc. 80; Wat. 10; Glyc. 10.	10 p. Red Cinchona; 8 p. Bitter Orange Peel; 2 p. Serpentaria.
		Guaiaci Ammoniata.	20	Spirit. Ammon. Aromaticus.	20 p. Guaiac.
		Valerianæ Ammoniata.	60	Spirit. Ammon. Aromaticus.	20 p. Valerian.
26	13½	Benzoini Compositæ.	. .	Alcohol.	12 p. Benzoin; 2 p. Aloes; 8 p. Storax; 4 p. Balsam of Tolu.
30	16½	Rhei Aromatica.	40	Dil. Alcohol.	20 p. Rhubarb; 4 p. Cinnamon; 4 p. Cloves; 2 p. Nutmeg.
35	. .	Ferri Chloridi.	. .	Alcohol.	35 p. Solution of Chloride of Iron.
40	19	Aconiti.	60	Alcohol.	40 p. Aconite (Root); .4 p. Tartaric Acid.
50		Ferri Acetatis.	. .	Alcohol.	50 p. Solution Acetate of Iron; 20 p. Acetic Ether.
	24	Veratri Viridis.	60	Alcohol.	50 p. Veratrum Viride.
		Tincturæ Herbarum Recentium.	Bruised.	Alcohol.	50 p. Fresh Herb.
65	36½	Tinctura Saponis Viridis.	. .	Alcohol.	65 p. Green Soap; 2 p. Oil of Lavender.

PRACTICAL PROCESSES FOR OFFICINAL TINCTURES.

TINCTURA ACONITI. *U.S.* Tincture of Aconite.

	By measure.
Aconite, in No. 60 powder, 400 parts, or	11 oz. av.
Tartaric Acid, 4 parts, or	48 grains.
Alcohol, a sufficient quantity,	
To make 1000 parts, or	2 pints.

Moisten the powder with *two hundred parts* [or 6 fl. oz.] of Alcohol, in which the Tartaric Acid has previously been dissolved, and macerate for twenty-four hours; then pack it firmly in a cylindrical glass percolator, and gradually pour Alcohol upon it, until *one thousand parts* [or 2 pints] of Tincture are obtained.

TINCTURA ALOES. *U.S.* Tincture of Aloes.

	By measure.
Purified Aloes, in moderately fine powder, 10 parts, or	3 oz. av.
Extract of Glycyrrhiza, in moderately fine powder, 10 parts, or	3 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the powders with *eighty parts* [or 1½ pints] of Diluted Alcohol, and macerate the mixture for seven days, in a closed vessel; then filter through paper, adding, through the filter, enough Diluted Alcohol to make the Tincture weigh *one hundred parts* [or measure 2 pints].

TINCTURA ALOES ET MYRRHÆ. *U.S.* Tincture of Aloes and Myrrh.

	By measure.
Purified Aloes, in moderately fine powder, 10 parts, or	3 oz. av.
Myrrh, in moderately fine powder, 10 parts, or	3 oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the powders with *eighty parts* [or 1½ pints] of Alcohol, and macerate the mixture for seven days, in a closed vessel; then filter through paper, adding, through the filter, enough Alcohol to make the Tincture weigh *one hundred parts* [or measure 2 pints].

TINCTURA ARNICÆ FLORUM. *U.S.* Tincture of Arnica Flowers.

[TINCTURA ARNICÆ, *Pharm.* 1870.]

	By measure.
Arnica Flowers, in No. 20 powder, 20 parts, or	6 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *forty parts* [or 12 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA ARNICÆ RADICIS. *U.S.* Tincture of Arnica Root.

	By measure.
Arnica Root, in No. 40 powder, 10 parts, or	3 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *ten parts* [or 3 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA ASAFŒTIDÆ. *U.S.* Tincture of Asafetida.

	By measure.
Asafetida, bruised, 20 parts, or	6 oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the Asafetida with *eighty parts* [or 1¼ pints] of Alcohol, and macerate for seven days, in a closed vessel; then filter through paper, adding, through the filter, enough Alcohol to make the Tincture weigh *one hundred parts* [or measure 2 pints].

TINCTURA AURANTII AMARI. *U.S.* Tincture of Bitter Orange Peel.

[TINCTURA AURANTII, *Pharm.* 1870.]

	By measure.
Bitter Orange Peel, in No. 30 powder, 20 parts, or	6 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *twenty parts* [or 6 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it moderately in a conical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA AURANTII DULCIS. *U.S.* Tincture of Sweet Orange Peel.

	By measure.
Sweet Orange Peel, recently separated from the fresh fruit and deprived of the inner, white layer, 20 parts, or	6 oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the Orange Peel, previously cut into small pieces, with *eighty parts* [or 1¼ pints] of Alcohol, and macerate for twenty-four hours; then pack it moderately in a conical percolator, and gradually pour Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA BELLADONNÆ. *U.S.* Tincture of Belladonna.

	By measure.
Belladonna Leaves, in No. 60 powder, 15 parts, or	5 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *twenty parts* [or 6 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA BENZOINI. *U.S.* Tincture of Benzoin.

	By measure.
Benzoin, in moderately coarse powder, 20 parts, or	6 oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the powder with *eighty parts* [or 1½ pints] of Alcohol, and macerate for seven days, in a closed vessel; then filter through paper, adding through the filter, enough Alcohol to make the Tincture weigh *one hundred parts* [or measure 2 pints].

TINCTURA BENZOINI COMPOSITA. *U. S.* **Compound Tincture of Benzoin.**

	By measure.
Benzoin, in coarse powder, 12 parts, or	3½ oz. av.
Purified Aloes, in coarse powder, 2 parts, or	260 grains.
Storax, 8 parts, or	2½ oz. av.
Balsam of Tolu, 4 parts, or	1¼ oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints

Mix the Benzoin, Aloes, Storax, and Balsam of Tolu with *seventy-five parts* [or 1½ pints] of Alcohol, and macerate the mixture for seven days, in a closed vessel; then filter through paper, adding, through the filter, enough Alcohol to make the Tincture weigh *one hundred parts* [or measure 2 pints].

TINCTURA BRYONIÆ. *U. S.* **Tincture of Bryonia.**

	By measure.
Bryonia, recently dried and in No. 40 powder, 10 parts, or	2¼ oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *ten parts* [or 2½ oz. av.] of Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA CALENDULÆ. *U. S.* **Tincture of Calendula.**

	By measure.
Calendula, in No. 20 powder, 20 parts, or	6 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *forty parts* [or 12 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA CALUMBÆ. *U. S.* **Tincture of Calumba.**

	By measure.
Calumba, in No. 20 powder, 10 parts, or	3 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix Alcohol and Water in the proportion of *three parts* [or 1½ pints] of Alcohol to *two parts* [or 12 fl. oz.] of Water, and, having moistened the powder with *ten parts* [or 3 fl. oz.] of the mixture, macerate for twenty-four hours; then pack it in a cylindrical percolator, and gradually pour menstruum upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA CANNABIS INDICÆ. *U.S.* **Tincture of Indian Cannabis.**

[TINCTURA CANNABIS, *Pharm.* 1870.]

	By measure.
Indian Cannabis, in No. 40 powder, 20 parts, or	5½ oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *twenty parts* [or 6 fl. oz.] of Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA CANTHARIDIS. *U.S.* **Tincture of Cantharides.**

	By measure.
Cantharides, in No. 60 powder, 5 parts, or	600 grains.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *three parts* [or 6 fl. dr.] of Alcohol, and pack it firmly in a cylindrical percolator; then gradually pour Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA CAPSICI. *U.S.* **Tincture of Capsicum.**

	By measure.
Capsicum, in No. 30 powder, 5 parts, or	600 grains.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix Alcohol and Water in the proportion of *nineteen parts* [or 2 pints] of Alcohol to *one part* [or 1½ fl. oz.] of Water, and, having moistened the powder with *three parts* [or 5 fl. dr.] of the mixture, pack it firmly in a cylindrical percolator; then gradually pour menstruum upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA CARDAMOMI. *U.S.* **Tincture of Cardamom.**

	By measure.
Cardamom, in No. 30 powder, 15 parts, or	5 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *fifteen parts* [or 4 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA CARDAMOMI COMPOSITA. *U.S.* **Compound Tincture of Cardamom.**

	By measure.
Cardamom, 20 parts, or	280 grains.
Cinnamon, 20 parts, or	280 grains.
Caraway, 10 parts, or	140 grains.
Cochineal, 5 parts, or	70 grains.
Glycerin, 60 parts, or	1½ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 1000 parts, or	2 pints.

Mix the Cardamom, Cinnamon, Caraway, and Cochineal, and reduce them to a moderately coarse (No. 40) powder. Having moistened the powder with *twenty-five parts* [or 6 fl. dr.] of Diluted Alcohol, pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *nine hundred and forty parts* [or 30½ fl. oz.] of Tincture are obtained; then add the Glycerin and mix them.

TINCTURA CATECHU COMPOSITA. *U.S.* **Compound Tincture of Catechu.**

[TINCTURA CATECHU, *Pharm.* 1870.]

	By measure.
Catechu, in No. 40 powder, 12 parts, or	4 oz. av.
Cinnamon, in No. 40 powder, 8 parts, or	2 oz. av. 300 gr.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the powders, and, having moistened the mixture with *fifteen parts* [or 4 fl. oz.] of Diluted Alcohol, macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA CHIRATÆ. *U.S.* **Tincture of Chirata.**

	By measure.
Chirata, in No. 40 powder, 10 parts, or	3 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *ten parts* [or 2½ fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or two pints] of Tincture are obtained.

TINCTURA CIMICIFUGÆ. *U.S.* **Tincture of Cimicifuga.**

	By measure.
Cimicifuga, in No. 60 powder, 20 parts, or	5½ oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *fifteen parts* [or 4½ fl. oz.] of Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA CINCHONÆ. *U.S.* **Tincture of Cinchona.**

	By measure.
Yellow Cinchona, in No. 60 powder, 20 parts, or	6 oz. av.
Glycerin, 10 parts, or	2½ fl. oz.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the Glycerin with *sixty-five parts* [or 23 fl. oz.] of Alcohol and *twenty-five parts* [or 7 fl. oz.] of Water, and, having moistened the powder with *twenty parts* [or 5½ fl. oz.] of the mixture, macerate for twenty-four hours; then pack it firmly in a cylindrical glass perco-

lator, and gradually pour on the remainder of the mixture. When the liquid has disappeared from the surface, gradually pour on more of the mixture of Alcohol and Water, using the same proportions as before, and continue the percolation, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA CINCHONÆ COMPOSITA. *U. S.* **Compound Tincture of Cinchona.**

	By measure.
Red Cinchona, 10 parts, or	3 oz. av.
Bitter Orange Peel, 8 parts, or	2½ oz. av.
Serpentaria, 2 parts, or	½ oz. av.
Glycerin, 10 parts, or	2½ fl. oz.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the Glycerin with *eighty parts* [or 28 fl. oz.] of Alcohol and *ten parts* [or 3 fl. oz.] of Water. Having mixed the Cinchona, Orange Peel, and Serpentaria, reduce them to a fine (No. 60) powder. Moisten the powder with *twenty parts* [or 5½ fl. oz.] of the menstruum, and macerate for twenty-four hours; then pack it firmly in a cylindrical glass percolator, and gradually pour on the remainder of the menstruum. When the liquid has disappeared from the surface, gradually pour upon it enough of a mixture of Alcohol and Water, using the same proportions as before, and continue the percolation, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA CINNAMOMI. *U. S.* **Tincture of Cinnamon.**

	By measure.
Cinnamon, in No. 40 powder, 10 parts, or	3 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix Alcohol and Water in the proportion of *three parts* [or 1½ pints] of Alcohol to *two parts* [or 14 fl. oz.] of Water, and, having moistened the powder with *five parts* [or 1½ fl. oz.] of menstruum, pack it in a conical percolator, and gradually pour menstruum upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA COLCHICI. *U. S.* **Tincture of Colchicum.**

	By measure.
Colchicum Seed, in No. 30 powder, 15 parts, or	5 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *fifteen parts* [or 4 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it moderately in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA CONII. *U. S.* **Tincture of Conium.**

	By measure.
Conium, in No. 30 powder, 150 parts, or	5 oz. av.
Diluted Hydrochloric Acid, 4 parts, or	1 fl. dr.
Diluted Alcohol, a sufficient quantity,	
To make 1000 parts, or	2 pints.

Moisten the powder with *forty-five parts* [or 2 fl. oz.] of Diluted Alcohol, previously mixed with the Diluted Hydrochloric Acid, and macerate for twenty-four hours; then pack it moderately in a conical glass percolator, and gradually pour Diluted Alcohol upon it, until *one thousand parts* [or 2 pints] of Tincture are obtained.

TINCTURA CROCI. *U. S.* Tincture of Saffron.

	By measure.
Saffron, 10 parts, or	3 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the Saffron with *ten parts* [or 2½ fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA CUBEBÆ. *U. S.* Tincture of Cubeb.

	By measure.
Cubeb, in No. 30 powder, 10 parts, or	3 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *ten parts* [or 2½ fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA DIGITALIS. *U. S.* Tincture of Digitalis.

	By measure.
Digitalis, recently dried and in No. 60 powder, 15 parts, or	5 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *fifteen parts* [or 4 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURÆ HERBARUM RECENTIUM. *U. S.* Tinctures of Fresh Herbs.

These Tinctures, when not otherwise directed, are to be prepared by the following formula:

Take of	By measure.
The Fresh Herb, bruised or crushed, 50 parts, or	16 oz.
Alcohol, 100 parts, or	2¼ pints.

Macerate the Herb with the Alcohol for fourteen days; then express the liquid and filter.

TINCTURA FERRI ACETATIS. *U. S.* Tincture of Acetate of Iron.

[Tincture of Ferric Acetate.]

	By measure.
Solution of Acetate of Iron, 50 parts, or	4 fl. oz.
Alcohol, 30 parts, or	3 fl. oz. 3 fl. dr.
Acetic Ether, 20 parts, or	2 fl. oz.
To make 100 parts, or	9 fl. oz.

Mix the Alcohol and Acetic Ether, and gradually add the Solution of Acetate of Iron, taking care that the mixture remains cool.

Keep the Tincture in glass-stoppered bottles, in a cool and dark place.

A clear, dark reddish-brown liquid, transparent in thin layers, having the odor of acetic ether, an acidulous and astringent taste, and a slightly acid reaction. Sp. gr. about 0.950. It is miscible, in all proportions, with water, without becoming turbid. The Tincture, diluted with water, affords a brownish-red precipitate with water of ammonia, and a blue one with test-solution of ferrocyanide of potassium. When mixed with sulphuric acid, and gently warmed, it evolves acetous vapors. If the iron be completely precipitated from a portion of the diluted Tincture by excess of water of ammonia, the filtrate should not yield either a white or a dark-colored precipitate with hydrosulphuric acid (abs. of zinc, copper). Another portion of the filtrate should not leave any fixed residue on evaporation and gentle ignition (abs. of fixed alkalies). A few drops added to freshly-prepared test-solution of ferricyanide of potassium should impart to the latter a pure greenish-brown color without a trace of blue (abs. of ferrous salt).

20 Gm. of the Tincture carefully evaporated and, after addition of a few drops of nitric acid, ignited, should yield a residue weighing 1.12 Gm.

TINCTURA FERRI CHLORIDI. *U. S.* Tincture of Chloride of Iron.

[TINCTURE OF FERRIC CHLORIDE.]

	By measure.
Solution of Chloride of Iron, 35 parts, or	8 fl. oz.
Alcohol, 65 parts, or	25 fl. oz.
To make 100 parts, or about	2 pints.

Mix the Solution with the Alcohol, and let it stand, in a closely-covered vessel, at least three months; then transfer it to glass-stoppered bottles.

A bright, brownish liquid of a slightly ethereal odor, a very astringent styptic taste, and an acid reaction. Sp. gr. about 0.980. The Tincture affords a brownish-red precipitate with water of ammonia, a blue one with test-solution of ferrocyanide of potassium, and a white one, insoluble in nitric acid, with test-solution of nitrate of silver. If the iron be completely precipitated from a portion of the Tincture by excess of water of ammonia, the filtrate should not yield either a white or a dark-colored precipitate with hydrosulphuric acid (abs. of zinc, copper). Another portion of the filtrate should leave no fixed residue on evaporation and gentle ignition (abs. of fixed alkalies). On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and the moderately diluted Tincture, the crystal should not become brown, nor should there be a brownish-black zone developed around it (abs. of nitric acid). A few drops added to freshly-prepared test-solution of ferricyanide of potassium should impart to the latter a pure greenish-brown color without a trace of blue (abs. of ferrous salt). On diluting 8 parts of the Tincture with distilled water to 100 parts, and boiling in a test-tube, the liquid should remain clear (abs. of oxychloride).

10 Gm. of the Tincture, when completely precipitated by excess of water of ammonia, yield a precipitate which, when washed, dried, and ignited, should weigh 0.652 Gm.

TINCTURA GALLÆ. *U. S.* Tincture of Nutgall.

	By measure.
Nutgall, in No. 40 powder, 20 parts, or	6 oz. av.
Glycerin, 10 parts, or	2½ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the Glycerin with *ninety parts* [or 30 fl. oz.] of Diluted Alcohol, and, having moistened the powder with ten parts of the mixture, pack it in a conical glass percolator; then gradually pour upon it, first, the remainder of the mixture, and afterward, Diluted Alcohol, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA GELSEMII. *U.S.* Tincture of Gelsemium.

	By measure.
Gelsemium, in No. 60 powder, 15 parts, or	4½ oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *ten parts* [or 3 fl. oz.] of Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Alcohol upon it, until *one hundred* parts [or 2 pints] of Tincture are obtained.

TINCTURA GENTIANÆ COMPOSITA. *U.S.* Compound Tincture of Gentian.

	By measure.
Gentian, 8 parts, or	5 oz. av.
Bitter Orange Peel, 4 parts, or	2½ oz. av.
Cardamom, 2 parts, or	1¼ oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	4 pints.

Mix the Gentian, Orange Peel, and Cardamom, and reduce the mixture to a moderately coarse (No. 40) powder. Moisten the powder with *ten parts* [or 6 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 4 pints] of Tincture are obtained.

TINCTURA GUAIACI. *U.S.* Tincture of Guaiac.

	By measure.
Guaiac, in coarse powder, 20 parts, or	5½ oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the powder with *eighty parts* [or 1½ pints] of Alcohol, and macerate for seven days, in a closed vessel; then filter through paper, adding, through the filter, enough Alcohol to make the Tincture weigh *one hundred parts* [or measure 2 pints].

TINCTURA GUAIACI AMMONIATA. *U.S.* Ammoniated Tincture of Guaiac.

	By measure.
Guaiac, in coarse powder, 20 parts, or	5½ oz. av.
Aromatic Spirit of Ammonia, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the powder with *eighty parts* [or 1½ pints] of Aromatic Spirit of Ammonia, and macerate for seven days, in a closed vessel; then filter through paper, adding, through the filter, Aromatic Spirit of Ammonia, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA HUMULI. *U.S.* Tincture of Hops.

	By measure.
Hops, well dried and in No. 20 powder, 20 parts, or	6 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *forty parts* [or 12 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA HYDRASTIS. *U.S.* Tincture of Hydrastis.

	By measure.
Hydrastis, in No. 60 powder, 20 parts, or	6 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *fifteen parts* [or 4½ fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA HYOSCYAMI. *U.S.* Tincture of Hyoscyamus.

	By measure.
Hyoscyamus, recently dried and in No. 60 powder, 15 parts, or	5 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *fifteen parts* [or 4½ fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA IGNATIÆ. *U.S.* Tincture of Ignatia.

	By measure.
Ignatia, in No. 60 powder, 10 parts, or	8 oz. av.
Alcohol,	
Water, each, a sufficient quantity.	

Mix Alcohol and Water in the proportion of *eight parts* [or 4½ pints] of Alcohol to *one part* [or ½ pint] of Water. Moisten the powder with *ten parts* [or ½ pint] of the menstruum, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it, until the Ignatia is exhausted. Reserve the first *ninety parts* [or 4½ pints] of the percolate, evaporate the remainder to *ten parts* [or ½ pint], and mix with the reserved portion. Of this Tincture take any convenient number of parts, and, by means of a water-bath, evaporate it to dryness. Weigh the resulting extract, and from its weight calculate the quantity of extract contained in the one hundred parts of Tincture obtained; then dissolve the dried extract in the remainder of the Tincture, and add enough of the above menstruum to make the product weigh so many parts that each *one hundred parts* of Tincture shall contain *one part* of dry extract. Lastly, mix thoroughly, and filter through paper.

Tincture of Ignatia thus prepared represents about 10 parts of Ignatia in 100 parts.

TINCTURA IODI. *U.S.* Tincture of Iodine.

[TINCTURA IODINII, *Pharm.* 1870.]

	By measure.
Iodine, 8 parts, or	250 grains.
Alcohol, 92 parts, or	½ pint.
To make 100 parts, or . . . about	½ pint.

Dissolve the Iodine in the Alcohol.

6.33 Gm. of the Tincture, mixed with a solution of 2 Gm. of iodide of potassium in 25 C.c. of water and a little gelatinized starch, should require, for complete decoloration, 40 C.c. of the volumetric solution of hyposulphite of sodium.

TINCTURA IPECACUANHÆ ET OPII. *U.S.* Tincture of Ipecac and Opium.

	By measure.
Deodorized Tincture of Opium, 100 parts, or	10 fl. oz.
Fluid Extract of Ipecac, 10 parts, or	1 fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	10 fl. oz.

Evaporate the Deodorized Tincture of Opium, on a water-bath, until it weighs *eighty-five parts* [or measures ½ pint]. When it has become cold, add to it the Fluid Extract of Ipecac, filter the mixture and pass enough Diluted Alcohol through the filter to make the Tincture weigh *one hundred parts* [or measure 10 fl. oz.].

TINCTURA KINO. *U.S.* Tincture of Kino.

	By measure.
Kino, 10 parts, or	360 grains.
Glycerin, 15 parts, or	1 fl. oz.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 parts, or	½ pint.

Mix the Glycerin with *sixty parts* [or 6 fl. oz.] of Alcohol and *fifteen parts* [or 10 fl. dr.] of Water. Rub the Kino in a mortar, adding, gradually, *thirty parts* [or 3 fl. oz.] of this menstruum, until a smooth paste is made; transfer this to a bottle, add the remainder of the menstruum, and macerate for twenty-four hours, occasionally shaking the bottle; then filter through paper, adding, through the filter, enough of a mixture of Alcohol and Water, made in the proportion of *four parts* [or 5 fl. dr.] of Alcohol to *one part* [or 1 fl. dr.] of Water, to make the Tincture weigh *one hundred parts* [or measure ½ pint].

Keep the Tincture in well-stopped bottles.

TINCTURA KRAMERIÆ. *U.S.* Tincture of Krameria.

	By measure.
Krameria, in No. 40 powder, 20 parts, or	6 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *twenty parts* [or 6 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA LAVANDULÆ COMPOSITA. *U. S.* **Compound Tincture of Lavender.**

[SPIRITUS LAVANDULÆ COMPOSITUS, *Pharm.* 1870.]

	By measure.
Oil of Lavender, 8 parts, or	1 fl. oz.
Oil of Rosemary, 2 parts, or	2 fl. dr.
Cinnamon, in coarse powder, 18 parts, or	2¼ oz. av.
Cloves, 4 parts, or	½ oz. av.
Nutmeg, 10 parts, or	1¼ oz. av.
Red Saunders, in coarse powder, 8 parts, or	1 oz. av.
Alcohol, 680 parts, or	6 pints.
Water, 270 parts, or	2 pints.
Diluted Alcohol, a sufficient quantity,	
To make 1000 parts, or	8 pints.

Dissolve the Oils in the Alcohol and add the Water. Crush the Nutmeg in a mortar, mix it with the Cinnamon, Cloves, and Red Saunders, and reduce the mixture, by grinding, to a coarse (No. 20) powder. Moisten the mixture with a sufficient quantity of the alcoholic solution of the Oils, pack it firmly in a cylindrical percolator, gradually pour upon it the remainder of the alcoholic solution, and afterward, Diluted Alcohol, until *one thousand parts* [or 8 pints] of Tincture are obtained.

TINCTURA LOBELIÆ. *U. S.* **Tincture of Lobelia.**

	By measure.
Lobelia, in No. 40 powder, 20 parts, or	6 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *twenty parts* [or 6 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA MATICO. *U. S.* **Tincture of Matico.**

	By measure.
Matico, in No. 40 powder, 10 parts, or	3 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the Matico with *ten parts* [or 3 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA MOSCHI. *U. S.* **Tincture of Musk.**

	By measure.
Musk, 10 parts, or	340 grains.
Alcohol, 45 parts, or	4 fl. oz.
Water, 45 parts, or	3½ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	½ pint.

Rub the Musk in a mortar, first, with a little of the Water, until a smooth mixture is made, and then with the remainder of the Water. Transfer the whole to a bottle, add the Alcohol, and macerate the mixture for seven days, occasionally shaking the bottle. Then filter through paper, adding, through the filter, enough Diluted Alcohol to make the Tincture weigh *one hundred parts* [or measure ½ pint].

TINCTURA MYRRHÆ. *U.S.* Tincture of Myrrh.

	By measure.
Myrrh, in moderately coarse powder, 20 parts, or	5½ oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the powder with *eighty parts* [or 1½ pints] of Alcohol, and macerate for seven days in a closed vessel; then filter through paper, adding, through the filter, enough Alcohol to make the Tincture weigh *one hundred parts* [or measure two pints].

TINCTURA NUCIS VOMICÆ. *U.S.* Tincture of Nux Vomica.

	By measure.
Nux Vomica, in No. 60 powder, 20 parts, or	16 oz. av.
Alcohol,	
Water, each, a sufficient quantity.	

Mix Alcohol and Water in the proportion of *eight parts* [or 4½ pints] of Alcohol to *one part* [or ½ pint] of Water. Moisten the powder with *twenty parts* [or 1 pint] of the menstruum, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it, until the Nux Vomica is exhausted. Reserve the first *ninety parts* [or 4½ pints] of the percolate, evaporate the remainder to *ten parts* [or ½ pint], and mix with the reserved portion. Of this Tincture take any convenient number of parts, and, by means of a water-bath, evaporate to dryness; weigh the resulting extract, and from its weight calculate the quantity of dry extract contained in the one hundred parts of Tincture; then dissolve the dried extract in the remainder of the Tincture, and add enough of the above menstruum to make the product weigh so many parts, that each *one hundred parts* of Tincture shall contain *two parts* of dry extract. Lastly, mix thoroughly, and filter through paper.

Tincture of Nux Vomica thus prepared represents about 20 parts of Nux Vomica in 100 parts.

TINCTURA OPII. *U.S.* Tincture of Opium.

	By measure.
Powdered Opium, 10 parts, or	1 oz. av.
Water, 40 parts, or	4 fl. oz.
Alcohol, 40 parts, or	4½ fl. oz.
Diluted Alcohol, a sufficient quantity.	
To make 100 parts, or	10 fl. oz.

Rub the Opium in a mortar, with the Water previously heated to the temperature of 90° C. (194° F.), until a smooth mixture is made, and macerate for twelve hours; then add the Alcohol, mix thoroughly, and transfer the whole to a conical percolator. Return to the perco-

lator the first portion of percolate, until it becomes clear, and, when the liquid ceases to drop, gradually pour on Diluted Alcohol, continuing the percolation until *one hundred parts* [or 10 fl. oz.] of Tincture are obtained.

TINCTURA OPII CAMPHORATA. *U.S.* **Camphorated Tincture of Opium.**

	By measure.
Powdered Opium, 4 parts, or	35 grains.
Benzoic Acid, 4 parts, or	35 grains.
Camphor, 4 parts, or	35 grains.
Oil of Anise, 4 parts, or	½ fl. dr.
Glycerin, 40 parts, or	5 fl. dr.
Diluted Alcohol, a sufficient quantity,	
To make 1000 parts, or	20 fl. oz.

Add *nine hundred parts* [or 18 fl. oz.] of Diluted Alcohol to the other ingredients, contained in a suitable vessel, and macerate for seven days, frequently stirring; then filter through paper, in a well-covered funnel, and pass enough Diluted Alcohol through the filter to make the product weigh *one thousand parts* [or measure 20 fl. oz.].

TINCTURA OPII DEODORATA. *U.S.* **Deodorized Tincture of Opium.**

	By measure.
Powdered Opium, 10 parts, or	450 grains.
Ether, 20 parts, or	2½ fl. oz.
Alcohol, 20 parts, or	2¼ fl. oz.
Water, a sufficient quantity,	
To make 100 parts, or about	10 fl. oz.

Rub the Opium in a mortar with *forty parts* [or 4 fl. oz.] of Water, gradually added, until thoroughly softened, and macerate for twelve hours; then express, and repeat the operation twice, using the same amount of Water each time. Mix the expressed liquids, evaporate the mixture to *ten parts* [or 1 fl. oz.], and, when it has cooled, shake it repeatedly with the Ether in a bottle. When the ethereal solution has separated by standing, pour it off, and evaporate the remaining liquid until all traces of Ether have disappeared. Mix the residue with *fifty parts* [or 5 fl. oz.] of Water, and filter the mixture through paper. When the liquid has ceased to pass, add enough Water, through the filter, to make the filtered liquid weigh *eighty parts* [or measure ½ pint]. Lastly, add the Alcohol and mix them.

TINCTURA PHYSOSTIGMATIS. *U.S.* **Tincture of Physostigma.**

	By measure.
Physostigma, in No. 40 powder, 10 parts, or	2¾ oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *ten parts* [or 3 fl. oz.] of Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA PYRETHRI. *U.S.* Tincture of Pyrethrum.

	By measure.
Pyrethrum, in No. 40 powder, 20 parts, or	5½ oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *fifteen parts* [or 5 fl. oz.] of Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA QUASSIÆ. *U.S.* Tincture of Quassia.

	By measure.
Quassia, in No. 40 powder, 10 parts, or	3 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *ten parts* [or 3 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA RHEI. *U.S.* Tincture of Rhubarb.

	By measure.
Rhubarb, 12 parts, or	4 oz. av.
Cardamom, 2 parts, or	290 grains.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the Rhubarb and Cardamom, and reduce the mixture to a moderately coarse (No. 40) powder; moisten the powder with *ten parts* [or 3 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA RHEI AROMATICA. *U.S.* Aromatic Tincture of Rhubarb.

	By measure.
Rhubarb, 20 parts, or	6½ oz. av.
Cinnamon, 4 parts, or	1¼ oz. av.
Cloves, 4 parts, or	1¼ oz. av.
Nutmeg, 2 parts, or	273 grains.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the Rhubarb, Cinnamon, Cloves, and Nutmeg, and reduce the mixture to a moderately coarse [No. 40] powder; moisten the powder with *fifteen parts* [or 4 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA RHEI DULCIS. *U. S.* **Sweet Tincture of Rhubarb.**

	By measure.
Rhubarb, 8 parts, or	2½ oz. av.
Glycyrrhiza, 4 parts, or	1¼ oz. av.
Anise, 4 parts, or	1¼ oz. av.
Cardamom, 1 part, or	140 grains.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the Rhubarb, Glycyrrhiza, Anise, and Cardamom, and reduce the mixture to a moderately coarse (No. 40) powder; moisten the powder with *fifteen parts* [or 4 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA SANGUINARIÆ. *U. S.* **Tincture of Sanguinaria.**

	By measure.
Sanguinaria, in No. 60 powder, 15 parts, or	4½ oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix Alcohol and Water in the proportion of *two parts* [or 25 fl. oz.] of Alcohol to *one part* [or 11 fl. oz.] of Water. Moisten the powder with *ten parts* [or 2 fl. oz.] of the mixture, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA SAPONIS VIRIDIS. *U. S.* **Tincture of Green Soap.**

	By measure.
Green Soap, 65 parts, or	10 oz. av.
Oil of Lavender, 2 parts, or	3 fl. dr.
Alcohol, a sufficient quantity,	
To make 100 parts, or	15 fl. oz.

Mix the Soap and Oil of Lavender with *thirty-three parts* [or 6 fl. oz.] of Alcohol, and let the mixture macerate until the Soap is dissolved; then filter through paper, adding Alcohol, through the filter, until *one hundred parts* [or 15 fl. oz.] of Tincture are obtained.

TINCTURA SCILLÆ. *U. S.* **Tincture of Squill.**

	By measure.
Squill, in No. 30 powder, 15 parts, or	5 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *twenty parts* [or 6 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it moderately in a conical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA SERPENTARIÆ. *U. S.* Tincture of Serpentaria.

	By measure.
Serpentaria, in No. 40 powder, 10 parts, or	3 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *ten parts* [or 3 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA STRAMONII. *U. S.* Tincture of Stramonium.

	By measure.
Stramonium Seed, in No. 40 powder, 10 parts, or	3 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *ten parts* [or 3 fl. oz.] of Diluted Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Diluted Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA SUMBUL. *U. S.* Tincture of Sumbul.

	By measure.
Sumbul, in No. 30 powder, 10 parts, or	2¼ oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *ten parts* [or 2½ fl. oz.] of Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA TOLUTANA. *U. S.* Tincture of Tolu.

	By measure.
Balsam of Tolu, 10 parts, or	3 oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Add the Balsam of Tolu to *ninety parts* [or 30 fl. oz.] of Alcohol, and macerate until dissolved; then filter through paper, adding, through the filter, enough Alcohol to make the Tincture weigh *one hundred parts* [or measure 2 pints].

TINCTURA VALERIANÆ. *U. S.* Tincture of Valerian.

	By measure.
Valerian, in No. 60 powder, 20 parts, or	6 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix Alcohol and Water in the proportion of *two parts* [or 25 fl. oz.] of Alcohol to *one part* [or 11 fl. oz.] of Water. Moisten the powder with *fifteen parts* [or 5 fl. oz.] of the mixture, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA VALERIANÆ AMMONIATA. *U.S.* **Ammoniated Tincture of Valerian.**

	By measure.
Valerian, in No. 60 powder, 20 parts, or	6 oz. av.
Aromatic Spirit of Ammonia, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *twenty parts* [or 6 fl. oz.] of Aromatic Spirit of Ammonia, and macerate for twenty-four hours, in a closed vessel; then pack it firmly in a cylindrical glass percolator, and gradually pour Aromatic Spirit of Ammonia upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA VANILLÆ. *U.S.* **Tincture of Vanilla.**

	By measure.
Vanilla, cut into small pieces and bruised, 10 parts, or	3 oz. av.
Sugar, in coarse powder, 20 parts, or	6 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix Alcohol and Water in the proportion of *two parts* [or 25 fl. oz.] of Alcohol to *one part* [or 11 fl. oz.] of Water; macerate the Vanilla in *fifty parts* [or 1 pint] of this mixture for twelve hours, then drain off the liquid, and set it aside. Transfer the Vanilla to a mortar, beat it with the Sugar into a uniform powder, then pack it in a percolator, and pour upon it the reserved liquid; when this has disappeared from the surface, gradually pour on menstruum, and continue the percolation, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA VERATRI VIRIDIS. *U.S.* **Tincture of Veratrum Viride.**

	By measure.
Veratrum Viride, in No. 60 powder, 50 parts, or	14 oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *fifteen parts* [or 5 fl. oz.] of Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

TINCTURA ZINGIBERIS. *U.S.* **Tincture of Ginger.**

	By measure.
Ginger, in No. 40 powder, 20 parts, or	5½ oz. av.
Alcohol, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the Ginger with *five parts* [or 1½ fl. oz.] of Alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour Alcohol upon it, until *one hundred parts* [or 2 pints] of Tincture are obtained.

Vina Medicata. *Medicated Wines.*

These are liquid preparations containing the soluble principles of medicinal substances dissolved in wine. Pharmaceutically they most

resemble tinctures, differing from them merely in the character of the menstruum. The fermented juice of the grape, known officinally as "vinum album," or "white wine," when brought to a definite alcoholic strength, is the menstruum used as the basis for medicated wines; and wines have the advantage over infusions and decoctions of being much more permanent preparations, on account of the presence of alcohol.

Although the stability of medicated wines is greatly improved by the requirements of the U.S.P. 1880 that they shall be made from stronger white wine, a menstruum containing from twenty per cent. to twenty-five per cent. of absolute alcohol by weight, it is apparent that more useful and permanent preparations could be made by substituting a menstruum composed of alcohol and water, and hence tinctures are preferable. Of the fourteen officinal wines, three are *not medicated*, four are made by *solution* or *admixture*, three by *maceration*, and four by *percolation*.

Table of the Officinal Wines.

Name.	Definition and Proportions.
Not Medicated.	
Vinum Album.	A pale amber-colored or straw-colored, alcoholic liquid, made by fermenting the unmodified juice of the grape, freed from seeds, stems, and skins.
Album Fortius.	7 p. White Wine; 1 p. Alcohol.
Rubrum.	A deep red, alcoholic liquid, made by fermenting the juice of colored grapes in presence of their skins.
Made by Solution.	
Vinum Antimonii.	4 p. Tartrate of Antimony and Potassium; 60 p. Boiling Distilled Water; sufficient Stronger White Wine to make 1000 p.
Ferri Amarum.	8 p. Solution Citrate of Iron and Quinine; 12 p. Tincture of Sweet Orange Peel; 36 p. Syrup; 44 p. Stronger White Wine.
Ferri Citratis.	4 p. Citrate of Iron and Ammonium; 12 p. Tincture of Sweet Orange Peel; 12 p. Syrup; 72 p. Stronger White Wine.
Ipecacuanhæ.	7 p. Fluid Extract of Ipecac; 93 p. Stronger White Wine.
Made by Maceration.	
Vinum Aloes.	6 p. Purified Aloes; 1 p. Cardamom; 1 p. Ginger (all in No. 40 powder); macerate with 90 parts Stronger White Wine for 7 days, filter, and add sufficient Stronger White Wine to make 100 p.
Colchici Seminis.	15 p. Colchicum Seed, No. 20 powder; sufficient Stronger White Wine to make 100 p.
Opii.	10 p. Powdered Opium; 1 p. Powdered Cinnamon; 1 p. Powdered Cloves; 90 p. Stronger White Wine; macerate for 7 days, filter, and add sufficient Stronger White Wine to make 100 p.
Made by Percolation.	
Vinum Aromaticum.	1 p. each of Lavender, Origanum, Peppermint, Rosemary, Sage, and Wormwood; percolate with sufficient Stronger White Wine to make 100 p.
Colchici Radicis.	40 p. Colchicum Root, No. 80 powder; percolate with sufficient Stronger White Wine to make 100 p.
Ergotæ.	15 p. Ergot, No. 30 powder; percolate with sufficient Stronger White Wine to make 100 p.
Rhei.	10 p. Rhubarb, No. 30 powder; 1 p. Calamus, No. 30 powder; percolate with sufficient Stronger White Wine to make 100 p.

VINUM ALBUM. White Wine.

A pale amber-colored or straw-colored, alcoholic liquid, made by fermenting the unmodified juice of the grape, free from seeds, stems, and skins.

White Wine should be preserved in well-closed, full casks or bottles, and in a cool place.

White Wine should contain not less than ten per cent. nor more than twelve per cent. by weight of absolute alcohol.

VINUM ALBUM FORTIUS. *U.S.* Stronger White Wine.

	By measure.
White Wine, 7 parts, or	55 fl. oz.
Alcohol, 1 part, or	9½ fl. oz.

Mix them.

Stronger White Wine should contain not less than *twenty per cent.* nor more than *twenty-five per cent.* of absolute alcohol, by weight.

VINUM ALOES. *U.S.* Wine of Aloes.

	By measure.
Purified Aloes, 6 parts, or	2 oz. av.
Cardamom, 1 part, or	146 grains.
Ginger, 1 part, or	146 grains.
Stronger White Wine, a sufficient quantity,	
To make 100 parts, or	2 pints.

Mix the Aloes, Cardamom, and Ginger, and reduce them to a moderately coarse (No. 40) powder. Macerate the powder with *ninety parts* [or 26 fl. oz.] of Stronger White Wine for seven days, with occasional agitation, and filter through paper, adding, through the filter, enough Stronger White Wine to make the filtered liquid weigh *one hundred parts* [or measure 2 pints].

VINUM ANTIMONII. *U.S.* Wine of Antimony.

	By measure.
Tartrate of Antimony and Potassium, 4 parts, or	58 grains.
Boiling Distilled Water, 60 parts, or	2 fl. oz.
Stronger White Wine, a sufficient quantity,	
To make 1000 parts, or	2 pints.

Dissolve the Tartrate of Antimony and Potassium in the Water, and, while the solution is hot, add *six hundred parts* [or 20 fl. oz.] of Stronger White Wine, and filter through paper, adding, through the filter, enough Stronger White Wine to make the filtered liquid weigh *one thousand parts* [or measure 2 pints].

VINUM AROMATICUM. *U.S.* Aromatic Wine.

	By measure.
Lavender, 1 part, or	72 grains.
Origanum, 1 part, or	72 grains.
Peppermint, 1 part, or	72 grains.
Rosemary, 1 part, or	72 grains.
Sage, 1 part, or	72 grains.
Wormwood, 1 part, or	72 grains.
Stronger White Wine, a sufficient quantity,	
To make 100 parts, or	1 pint.

Mix the solid ingredients, and reduce them to a coarse (No. 20) powder. Moisten the powder with *four parts* [or 6 fl. dr.] of Stronger White Wine, pack it moderately in a conical glass percolator, and gradually pour enough Stronger White Wine upon it to make the filtered liquid weigh *one hundred parts* [or measure 1 pint].

VINUM COLCHICI RADICIS. *U.S.* **Wine of Colchicum Root.**

	By measure.
Colchicum Root, in No. 30 powder, 40 parts, or	13 oz. av.
Stronger White Wine, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *ten parts* [or 4 fl. oz.] of Stronger White Wine, pack it moderately in a conical percolator, and gradually pour enough Stronger White Wine upon it to make the filtered liquid weigh *one hundred parts* [or measure 2 pints].

VINUM COLCHICI SEMINIS. *U.S.* **Wine of Colchicum Seed.**

	By measure.
Colchicum Seed, in No. 20 powder, 15 parts, or	5 oz. av.
Stronger White Wine, a sufficient quantity,	
To make 100 parts, or	2 pints.

To the powder add *ninety parts* [or 28 fl. oz.] of Stronger White Wine, and macerate for seven days, with occasional agitation; then filter through paper, adding, through the filter, enough Stronger White Wine to make the filtered liquid weigh *one hundred parts* [or measure 2 pints].

VINUM ERGOTÆ. *U.S.* **Wine of Ergot.**

	By measure.
Ergot, recently ground and in No. 30 powder, 15 parts, or	5 oz. av.
Stronger White Wine, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the powder with *four parts* [or 10 fl. dr.] of Stronger White Wine, pack it moderately in a cylindrical percolator, and gradually pour enough Stronger White Wine upon it to make the filtered liquid weigh *one hundred parts* [or measure 2 pints].

VINUM FERRI AMARUM. *U.S.* **Bitter Wine of Iron.**

	By measure.
Solution of Citrate of Iron and Quinine, 8 parts, or	17 fl. dr.
Tincture of Sweet Orange Peel, 12 parts, or	4 fl. oz.
Syrup, 36 parts, or	10 fl. oz.
Stronger White Wine, 44 parts, or	1 pint.
To make 100 parts, or	2 pints.

Mix and filter through paper.

VINUM FERRI CITRATIS. *U.S.* **Wine of Citrate of Iron.**

	By measure.
Citrate of Iron and Ammonium, 4 parts, or	580 grains.
Tincture of Sweet Orange Peel, 12 parts, or	5 fl. oz.
Syrup, 12 parts, or	3 fl. oz.
Stronger White Wine, 72 parts, or	23 fl. oz.
To make 100 parts, or about	2 pints.

Mix and filter through paper.

VINUM IPECACUANHÆ. *U.S.* **Wine of Ipecac.**

	By measure.
Fluid Extract of Ipecac, 7 parts, or	20 fl. dr.
Stronger White Wine, 93 parts, or	30 fl. oz.
To make 100 parts, or about	2 pints.

Mix and filter through paper

VINUM OPII. *U.S.* **Wine of Opium.**

	By measure.
Powdered Opium, 10 parts, or	456 grains.
Cinnamon, in No. 60 powder, 1 part, or	45 grains.
Cloves, in No. 30 powder, 1 part, or	45 grains.
Stronger White Wine, a sufficient quantity,	
To make 100 parts, or	10 fl. oz.

To the mixed powders add *ninety parts* [or 9 fl. oz.] of Stronger White Wine, and macerate the mixture for seven days, with occasional agitation; then transfer it to a filter, and gradually pour enough Stronger White Wine upon it to make the filtered liquid weigh *one hundred parts* [or measure 10 fl. oz.].

VINUM RHEI. *U.S.* **Wine of Rhubarb.**

	By measure.
Rhubarb, in No. 30 powder, 10 parts, or	3¼ oz. av.
Calamus, in No. 30 powder, 1 part, or	140 grains.
Stronger White Wine, a sufficient quantity,	
To make 100 parts, or	2 pints.

Moisten the mixed powders with *five parts* [or 1½ fl. oz.] of Stronger White Wine, pack the mixture in a conical glass percolator, and gradually pour enough Stronger White Wine upon it to make the filtered liquid weigh *one hundred parts* [or measure 2 pints].

VINUM RUBRUM. **Red Wine.**

A deep red, alcoholic liquid, made by fermenting the juice of colored grapes in presence of their skins.

Red Wine should be preserved in well-closed, full casks or bottles, and in a cool place.

Red Wine should contain not less than 10 per cent. nor more than 12 per cent. by weight of absolute alcohol.

Extracta Fluida. *Fluid Extracts.*

Fluid extracts are liquid alcoholic preparations of uniform and definite strength, made by percolating drugs with menstrua, and concentrating a portion of the percolate so that in each case a cubic centimetre represents the medicinal virtues of one gramme of the drug: they are mostly concentrated tinctures. Fluid extracts were officinal for the first time in 1850, and the list was then made up of *seven* concentrated preparations, although but *one* of these could be called a fluid extract within the present meaning of the term; of the seven, two were oleoresins, four were concentrated syrups, and but one a concentrated tincture. Since 1850 the use of fluid extracts has increased to an enormous extent,

and the Pharmacopœia of 1880 contains formulas for *seventy-nine*, the list embracing a greater number than any other class of preparations in the work. Fluid extracts may be justly called "American preparations," and the advance made in pharmacy in this country within the last quarter of a century is largely due to the stimulus given to the studies in percolation by the demand for these useful liquids. The striking advantages possessed by fluid extracts are—1. Permanence. 2. Concentration. 3. The uniform relation existing between the fluid extract and the drug.

Permanence is secured by the adoption of alcoholic menstrua: formerly, sugar and glycerin were relied upon as preservatives, but continued experience has developed the value of alcohol, so that at present it is exclusively used as the antiseptic.

Concentration enables the physician to decrease the bulk of the dose, diminishing the volume of the preparation so that portability is secured. It also aids greatly in securing permanence.

The uniform relation existing between the fluid extract and the drug is of great assistance to the physician in fixing the dose, because, as one cubic centimetre is represented by one gramme, the dose of the fluid extract must be practically the same as that of the drug. It has also obvious advantages in arranging the formulas and working from them. The present strength of fluid extracts renders them five per cent. weaker than the fluid extracts of U. S. P. 1870: this is practically of no significance, so long as the drugs themselves are not brought to a standard to limit the amount of moisture or active principles present; for there would be more variation than five per cent. between different lots of the same drug, in these particulars: indeed, the proposition to make fluid extracts just half their present strength has met with favor from many able pharmacists, the principal arguments being that more thorough exhaustion can be secured by the ordinary operator upon the small scale, and that the fluid extracts can be made to represent the drug more accurately and honestly when *one hundred* parts by measure are made from *fifty* parts by weight of drug than when one hundred parts by measure are made from one hundred parts by weight of drug. The standard of strength of the officinal fluid extracts is based upon the theory that from a given weight of drug an amount of fluid extract shall be made equal in measure to the bulk of the same weight of distilled water; in other words, the relation of gramme to cubic centimetre.

Preparation.—Fluid extracts are made in several ways. The manufacturer generally adopts a different process from that directed by the Pharmacopœia, because upon the large scale some practical modifications are necessary: the finished preparation is, however, generally brought to the officinal standard. The processes at present in use may be classified as follows: 1. Percolation with partial evaporation (officinal). 2. Percolation with incomplete exhaustion. 3. Repercolation. 4. Maceration with hydraulic pressure. 5. Vacuum maceration with percolation.

1. **Percolation with Partial Evaporation.**—This process can be best described by selecting from the officinal formulas one which will serve as an example.

Typical Formula for an Officinal Fluid Extract.

100 *Gm. of the powdered drug is moistened with a certain quantity of menstruum, packed in a suitable percolator, and enough menstruum added to saturate the powder and leave a stratum above it; the lower orifice of the percolator is closed when the liquid begins to drop, and the percolator is closely covered to prevent evaporation and permit maceration for a specified time; additional menstruum is poured on and percolation continued until the drug is exhausted. Usually from seven- to nine-tenths of the first portion of the percolate is reserved, and the remainder evaporated at a temperature not exceeding* 50° *C.* (122° *F.*) *to a soft extract; this is to be dissolved in the reserved portion, and enough menstruum added to make the fluid extract measure* 100 *C.c.* The precipitation experienced heretofore when the evaporated weak percolate was added to the reserved portion is considerably diminished by causing the former to be evaporated to a soft extract. This precipitation, formerly noticed more particularly in alcoholic fluid extracts, was due to the volatility of the alcohol in the weak percolates, which, when evaporated, left the residue to a great extent aqueous; when this residue was added to the strongly alcoholic reserved portion, a precipitation of resinous and frequently of active matter took place, which necessitated the storing of the fluid extract until precipitation ceased, and subsequent filtration. This is almost altogether avoided by evaporating to a soft extract, and the loss of activity through precipitation thus greatly diminished.

The argument is frequently advanced that the application of heat is detrimental to solutions of organic principles, that it dissociates some, and always proves injurious to the desirable constituents, *and that no heat whatever should be used in making fluid extracts:* these views are undoubtedly correct, when considered in connection with a few special cases, but do not apply with any practical force to the moderate use of heat recommended by the officinal processes upon that portion of the percolate which represents the least active and least desirable constituents of the drug; for from seven-tenths to nine-tenths of the whole amount of percolate (frequently representing ninety-five per cent. of the activity of the drug) is reserved and is not subjected to heat at all.

2. **Percolation with Incomplete Exhaustion.**—This process consists in percolating a given weight of a drug with the proper menstruum in the usual manner, and stopping the percolation when an amount of percolate has been received which is equal to about three-fourths of the weight of the drug. To illustrate: 1000 grammes, or 16 ounces, of drug is percolated with the menstruum until 750 C.c., or 12 fluidounces, of percolate has been received; this is the complete process, and the residue containing absorbed menstruum is sacrificed. This method has the merit of saving time and labor, and avoiding evaporation with the necessary contact of heat. It is based on the assumption that when percolation is properly conducted the first seventy-five per cent. of percolate received contains at least seventy-five per cent. of the soluble and desirable principles of the drug, and that the wastage of alcohol comes chiefly from the effort to obtain the last twenty-five per cent. or less of soluble principles. In addition, this smaller amount of extrac-

tive matter in the weak percolate is said to be lessened in activity by the effects of the heat during the evaporation to recover the alcohol from it: hence the argument that in carefully-conducted operations the active matter left after receiving the percolate representing seventy-five per cent. of the drug, does not represent twenty-five per cent. of activity, but oftentimes less than ten per cent. The principal disadvantage of this method is that the *strength* of the finished fluid extract depends *entirely* upon the *skill* and *care* of the operator. If careful, in one operation he may obtain seventy-five per cent. of the active principles in the first seventy-five per cent. of percolate; in another case, circumstances may prevent his obtaining more than fifty per cent. of the active principles in the first seventy-five per cent. of percolate. By this method of making fluid extracts he cannot invariably secure uniformity, whilst in making fluid extracts by the officinal process a valuable check always exists,—*i.e., that percolation proceeds until exhaustion is reached, the weak percolate is evaporated at a limited temperature, and the soft extract is incorporated with the reserved portion*, so that imperfect percolation happening in the first part of the process is compensated for in the latter part, the only difference being that the weak percolate in this case contains a larger proportion of activity than if the operation had been thoroughly conducted from the first.

3. **Repercolation.**—This process, already treated of under the head of percolation (see page 242), is an improvement upon the method just noticed, because the drug is percolated to exhaustion, and evaporation obviated by storing away the weak percolate until the next operation upon the same drug, when it is used in the place of fresh menstruum. This process may be best explained by selecting a typical fluid extract and noting the details.

Fluid Extract of Cinchona by Repercolation (Squibb).—Take of Yellow Cinchona, in powder No. 50, 32 parts; Stronger Alcohol, sp. gr. .819, 2 parts; Glycerin, sp. gr. 1.259, 1 part; Water, 2 parts, or a sufficient quantity of menstruum.

Weigh the Stronger Alcohol, Glycerin, and Water in succession, in any convenient quantity at a time, into a tared bottle, and mix them thoroughly for a menstruum.

Moisten 8 parts of the Cinchona with 8 parts of the menstruum, by thoroughly mixing them, and allow the mixture to stand 8 hours in a closely-covered vessel. Then pass the moist powder through a No. 8 sieve, and pack it firmly in a percolator. Pour menstruum on top until the mass is filled with liquid and a stratum remains on top unabsorbed; cover the percolator closely, and macerate for 48 hours. Then arrange the percolator for an automatic supply of menstruum, and start the percolation at such a rate as to give 1 part of percolate in about 4 hours. Reserve the first 6 parts of percolate, and continue the percolation until the Cinchona is exhausted, separating the percolate received after the reserved portion into fractions of about 8 parts each.

Moisten a second portion of 8 parts of the Cinchona with 8 parts of the weak percolate,—the first portion that was obtained next after the reserved percolate,—and allow the moist powder to stand for 8 hours in a vessel closely covered. Then pack it moderately in a percolator, and

supply the percolator automatically with the remaining fractions of the weak percolate in the order in which they were received, and finally with fresh menstruum, until the Cinchona is exhausted. Percolate in the same manner and at the same rate as with the first portion of Cinchona, and, reserving 8 parts of the first percolate, separate the weaker percolate into fractions of about 8 parts each.

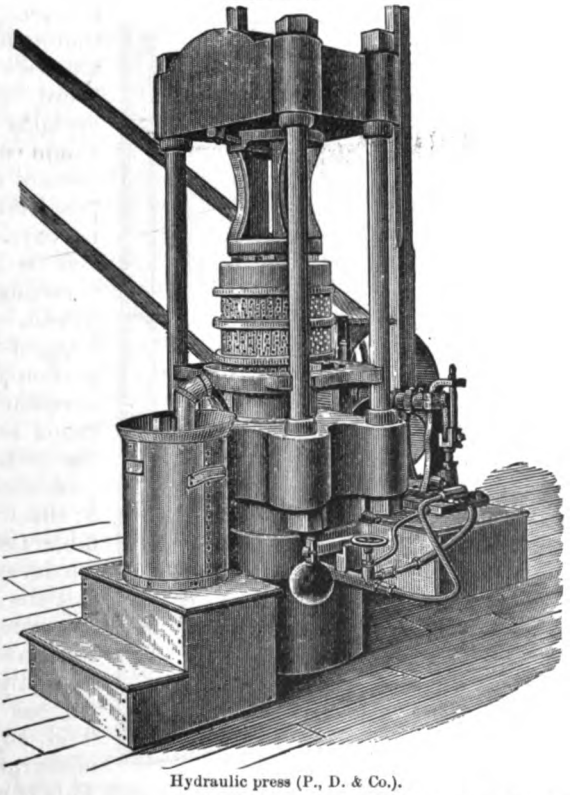
Percolate the third and fourth portions of 8 parts each of the Cinchona in the same way as the second portion.

Finally, mix the four reserved percolates together to make 30 parts of finished fluid extract; and, having corked, labelled, and numbered the bottles containing the fractions of weak percolate, set them away until the process for Cinchona is to be resumed.

When this fluid extract is to be again made, repeat the process as with the second portion, and reserve 8 parts of the first percolate as finished fluid extract from each 8 parts of Cinchona from that time forward so long as the fractions of weak percolate are carried forward with which to commence each operation.

4. Percolation and Maceration with Hydraulic Pressure.—These are the principal methods used by Parke, Davis & Co. in the preparation of fluid extracts: they are, of course, not practicable upon a small scale. The following description of the processes, with typical formulas, was furnished the author upon application to Geo. S. Davis, of Detroit. The following formula illustrates percolation with hydraulic pressure:

FIG. 327.



Hydraulic press (P., D. & Co.).

Fluid Extract of Podophyllum.—One hundred pounds of the drug, in No. 30 powder, are moistened in the usual way with the menstruum, consisting of a mixture of two volumes of alcohol and one volume of water; it is packed in a suitable percolator, and more of the menstruum is then added, exactly as in the ordinary U. S. P. process: the drug is allowed to

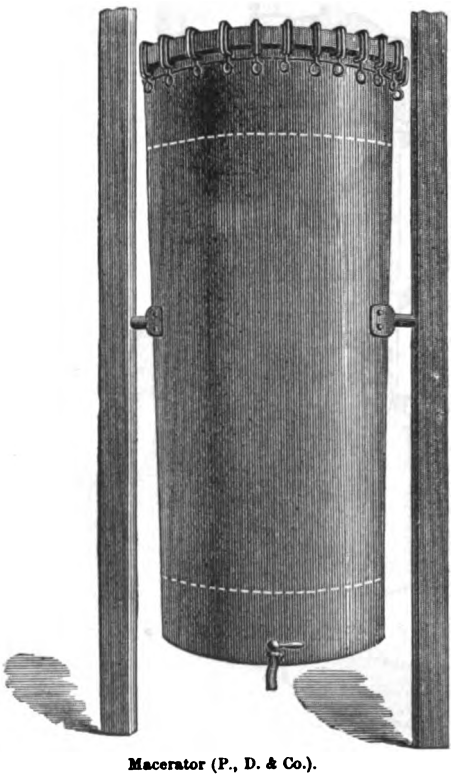
macerate four days. Percolation is then commenced, and allowed to proceed slowly until 120 pints of menstruum have been added to the powder, and all dropping has ceased. The upper stratum, amounting to about one-fifth of the drug, is then removed from the percolator, placed in a suitable canvas sack, and pressed out in the hydraulic press (see Fig. 327). The fluid obtained is poured upon the rest of the moist powder in the percolator, and when dropping has again ceased a second portion of the drug is pressed out as before, and this process is repeated until the whole of the drug has been pressed. The fluid obtained by the last pressing, together with the reserved percolate, which should amount to 95 pints, constitutes the fluid extract.

The marc will be found to contain almost no resin if the operation has been carefully conducted, particularly if a little of the menstruum is reserved to be added towards the close of the operation.

The following illustration shows the method of exhausting a drug which yields its soluble principles more readily than podophyllum. The process is maceration with hydraulic pressure.

Fluid Extract of Burdock.—Burdock Root, in No. 20 powder, 100 pounds; menstruum, diluted alcohol. Moisten the drug thoroughly, place in a macerator (see Fig. 328) (a cylindrical vessel mounted on uprights by trunnions, having a tight cover). Add about 120 pints of menstruum, cover the powder closely, and macerate ten days. The action of the solvent is greatly facilitated by inverting the macerator at intervals. The solvent is thus brought in contact with every portion of the powder, and a complete equilibrium of saturation is established between the principal volume of the menstruum and that contained in the interstices of the vegetable tissues. At the end of ten days the drug is pressed out, and the marc returned to the macerator, together with menstruum enough to make up the desired yield. Thus, if pressing has yielded 80 pints of fluid, 15½ pints of additional menstruum will be required. This is macerated two or three days, and then pressed. The product of these two expressions constitutes the finished fluid extract. Exhaustion of the drug by this process

FIG. 328.

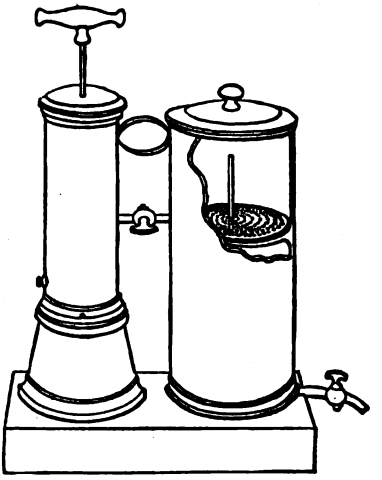


Macerator (P., D. & Co.).

is not so complete as by that previously described, but is generally sufficiently so for all practical purposes. Leaves, however, and compact barks, seeds, etc., unless reduced to an unmanageably fine powder, require a supplementary treatment of the marc by maceration and pressing, to procure a weak fluid which can be employed in a subsequent operation as menstruum for moistening and macerating the drug.

5. **Vacuum Maceration followed by Percolation.**—This method of making fluid extracts was proposed in 1869 by S. P. Duffield. His original process was to introduce the drug, ground to the requisite fineness, into a strong cylinder connected with an air-pump. The air was exhausted by the pump, and through a syphon-tube the requisite amount of menstruum was sucked into the vacuum-chamber. The air enclosed in the interstices and pores of the drug was thus expelled, and, the menstruum being brought immediately in contact with the soluble constituents, maceration was facilitated. The same process was suggested by Needles many years ago. Fig. 329 is an illustration of his original apparatus, the vessel upon the right hand being the percolator and receiver, the pump for exhausting the receiver being connected by a short tube carrying a stop-cock. The most effective apparatus known to the author for using this principle upon the large scale is that devised by Wm. M. Thomson, of Philadelphia, and illustrated in the American Journal of Pharmacy, page 237, 1882. The percolators are egg-shaped, and made of tinned copper; they are capable of being tightly covered, and communicate with a very efficient double-acting air-pump by means of stop-cocks above and below, and iron and stout rubber tubing. The moistened powder is packed tightly in the percolator, and the cover securely bolted on. The stop-cock in the cover, communicating with the air-pump, is opened, and a partial vacuum created in the space above the moistened drug; it is then closed, and another stop-cock in the cover opened, which communicates by a tube with the reservoir containing the menstruum. The menstruum quickly penetrates the powder, taking the place of the interstitial air, and when the powder is saturated it is permitted to macerate *in vacuo* a sufficient length of time. To start percolation, a receiver is connected with the beak of the percolator, and the air exhausted from it. When the flow slackens, air may be forced by the pump into the space above the powder, and the receiver again exhausted below. In this way entire control of these powerful physical forces may be secured. The advantages are apparent in preventing the loss of alcohol and protecting from chemical change caused by exposure to the air. It is quite

FIG. 329.



Needles's vacuum percolator.

possible to make an officinal fluid extract without recourse to the subsequent evaporation of weak percolate.

Preservation of Fluid Extracts.—Very little trouble is experienced in keeping fluid extracts which have been properly made. They should be placed in glass vessels and stored in rooms of uniform temperature: precipitation to a greater or less extent will certainly take place. This is often especially noticeable in fluid extracts made during warm weather, and is due to the greater solvent action of the menstruum at higher temperatures. Precipitation is also caused by the variation in the strength of different portions of the menstruum in an alcoholic fluid extract: the first part of the percolate which is received contains the displaced water which was present as moisture in the powder, and the mixture of this with the strong alcoholic percolate which follows causes in time precipitation. The character of the precipitates should be ascertained: if active, they should be incorporated by shaking with the fluid extract; if inert, they should be filtered out.

Officinal Fluid Extracts arranged in Classes according to the Alcoholic Strength of their Menstrua, with Manipulative Notes.

Name.	Percentage by Weight used to Moisten.	Menstruum.	Percentage by Volume of Reserve.	Process and Remarks.
Class 1.		**Alcohol.**	C.c.	
Extractum Aconiti Fluidum.	40	"	90	From Aconite Root; Tartaric Acid 1 p.c.
Aromaticum.	35	"	85	From Aromatic Powder.
Belladonnæ.	35	"	90	
Brayeræ.	40	"	90	
Calami.	35	"	90	
Cannabis Indicæ.	30	"	90	
Capsici.	50	"	90	
Cimicifugæ.	25	"	90	
Cubebæ.	25	"	90	
Cypripedii.	35	"	85	
Eucalypti.	35	"	85	
Gelsemii.	30	"	90	
Lupulini.	20	"	70	
Mezerei.	40	"	90	
Sabinæ.	25	"	90	
Sanguinariæ.	30	"	85	
Scillæ.	20	"	75	
Veratri Viridis.	30	"	90	
Xanthoxyli.	25	"	90	
Zingiberis.	25	"	90	
Ipecacuanhæ.	35	"		Percolate the Ipecac with Alcohol until it is exhausted; distil off the Alcohol until the residue measures 50 C.c., add to this 100 C.c. of water; evaporate the mixture to 75 C.c., and, when cool, filter. Wash the precipitate upon the filter with water until the washings are tasteless; evaporate all to 50 C.c. Cool, and add enough Alcohol to make 100 C.c.

Percolate with the menstruum directed until the drug is exhausted, reserving the number of C.c. set opposite each fluid extract in the proper column; evaporate or distil the rest of the percolate at a temperature not above 122° F. to a soft extract. Dissolve this in the reserved portion, and add sufficient Alcohol to make the whole measure 100 C.c.

Officinal Fluid Extracts.—(*Continued.*)

Name.	Percentage by Weight used to Molsten.	Menstruum.	Percentage by Volume of Reserve.	Process and Remarks.
Class 2.		**Alcohol, 8. Water, 1.**	C.c.	
Extractum Nucis Vomicæ Fluidum.	100		90	Macerate the Nux Vomica with 100 C.c. of the menstruum in a warm place for 48 hours; percolate until exhausted; distil off the Alcohol from the weak percolate; evaporate residue to a soft extract; dissolve this in the reserved portion and make up with menstruum to 100 C.c.
Class 3.		**Alcohol, 3. Water, 1.**		
Digitalis.	35	" "	85	Mix the Alcohol and Water, and exhaust the drug with the menstruum; reserve the number of C.c. directed, and distil or evaporate the remainder to a soft extract; add this to the reserved portion and sufficient menstruum to make 100 C.c.
Grindeliæ.	30	" "	85	
Guaranæ.	20	" "	80	
Hydrastis.	30	" "	85	
Hyoscyami.	40	" "	90	
Iridis.	40	" "	90	
Podophylli.	30	" "	85	
Rhei.	40	" "	75	
Serpentariæ.	30	" "	90	
Stramonii.	20	" "	90	
Class 4.		**Alcohol, 2. Water, 1.**		
Aurantii Amari.	35	" "	80	
Buchu.	30	" "	85	
Colchici Radicis.	35	" "	85	
Colchici Seminis.	30	" "	85	
Senegæ.	45	" "	85	With 2 p.c. Water of Ammonia to Fluid Extract to dissolve Pectin.
Valerianæ.	30	" "	85	
Viburni.	30	" "	85	
Class 5.		**Diluted Alcohol.**		
Arnicæ Radicis.	40	" "	90	Exhaust the drug with the menstruum, reserving the number of C.c. directed; evaporate the remainder to a soft extract, dissolve this in the reserved portion and add sufficient Diluted Alcohol to measure 100 C.c.
Calumbæ.	30	" "	70	
Conii.	30	" "	90	
Dulcamaræ.	40	" "	80	
Erythroxyli.	45	" "	80	
Eupatorii.	40	" "	80	
Gentianæ.	35	" "	80	
Glycyrrhizæ.	35	" "	75	
Lobeliæ.	35	" "	85	
Pilocarpi.	35	" "	85	
Quassiæ.	40	" "	90	
Rumicis.	35	" "	80	
Spigeliæ.	30	" "	85	
Stillingiæ.	30	" "	85	

Officinal Fluid Extracts.—(*Continued.*)

Name.	Percentage by Weight used to Moisten.	Menstruum.	Percentage by Volume of Reserve.	Process and Remarks.
Class 6.		Containing Glycerin.	C.c.	
Extractum Gossypii Radicis Fluidum.	50	Glycerin, 35 Alcohol, 65	70	From Cotton Root Bark; finish percolation with Alcohol.
Chimaphilæ.	40	Glycerin, 10 Dil. Alc., 90	70	Finish percolation with Diluted Alcohol.
Chiratæ.	35	Glycerin, 10 Dil. Alc., 90	85	" " "
Geranii.	35	Glycerin, 10 Dil. Alc., 90	70	" " "
Rhois Glabræ.	35	Glycerin, 10 Dil. Alc., 90	80	" " "
Rosæ.	40	Glycerin, 10 Dil. Alc., 90	75	" " "
Uvæ Ursi.	35	Glycerin, 10 Dil. Alc., 90	70	" " "
Leptandræ.	40	Glycerin, 15 Dil. Alc., 85	80	" " "
Cornus.	30	Glycerin, 20 Dil. Alc., 80	85	" " "
Krameriæ.	40	Glycerin, 20 Dil. Alc., 80	70	" " "
Pareiræ.	40	Glycerin, 20 Dil. Alc., 80	85	" " "
Cinchonæ.	35	Glycerin, 25 Alcohol, 75	75	Finish percolation with Alcohol, 3; Water, 1.
Matico.	30	Glycerin, 10 Alcohol, 75 Water, 25	85	" " "
Rubi.	35	Glycerin, 20 Alcohol, 45 Water, 35	70	Finish percolation with Alcohol, 9; Water, 7.
Sarsaparillæ Compositum.	40	Glycerin, 10 Alcohol, 30 Water, 60	80	Sarsaparilla, 75; Glycyrrhiza, 12; Sassafras Bark, 10; Mezereum, 3. Finish percolation with Alcohol, 1; Water, 2.
Sarsaparillæ.	40	Glycerin, 10 Alcohol, 30 Water, 60	80	Finish percolation with Alcohol, 1; Water, 2.
Pruni Virginianæ.	50	Water, 2 Glycerin, 1	80	Finish percolation with Diluted Alcohol; evaporate the first 120 C.c. of weak percolate to a thin syrup; distil off Alcohol from the remainder, and evaporate the residue to a thin syrup; unite these syrupy liquids, and evaporate them to a soft extract; dissolve this in the reserved portion and add Diluted Alcohol to 100 C.c.
Class 7.		Alcohol, 3. Water, 4.		
Sennæ.	40	" "	80	Finish percolation with Alcohol, 3; Water, 4.
Ergotæ.	30	" "	85	" " " Add 6 p.c. of Diluted Hydrochloric Acid to the weak percolate before evaporation, to fix alkaloids.

Officinal Fluid Extracts.—(*Continued.*)

Name.	Percentage by Weight used to Moisten.	Menstruum.	Percentage by Volume of Reserve.	Process and Remarks.
Class 8.		**Alcohol, 2. Water, 3.**	C.c.	
Extractum Taraxaci Fluidum.	30	" "	85	Finish percolation with Alcohol, 2; Water, 3.
Class 9.		**Alcohol, 1. Water, 2.**		
Frangulæ.	35	" "	80	Finish percolation with Alcohol, 1; Water, 2.
Hamamelidis.	35	" "	85	" " "
Scutellariæ.	35	" "	80	" " "
Class 10.		**Alcohol. Water.**		
Lactucarii.		" "		Macerate 100 Gm. Lactucarium with an equal weight of Ether, add 3 times its weight of Water, agitate, distil off the Ether; add Alcohol, macerate, express, filter, and reserve filtrate; macerate dregs repeatedly with Alcohol, 1; Water, 3; filter liquids from dregs, evaporate to 60 p.c. of weight of Lactucarium, unite this filtrate with reserved filtrate, add Alcohol and Water to 100 C.c.; decant clear liquid, wash precipitate with Alcohol, 3; Water, 4; concentrate washings, mix with decanted liquid, add sufficient Alcohol and Water to make up to 100 C.c.
Class 11.		**Boiling Water.**		
Tritici.		" "		Percolate the Triticum with Boiling Water until exhausted, evaporate to 80 p.c., add 20 p.c. of Alcohol, filter, make up quantity with Alcohol, 1; Water, 4; to 100 p.c.
Castaneæ.	500	" "	200	Macerate 100 Gm. Castaneæ with Boiling Water, express, percolate residue to exhaustion; mix liquids, evaporate, add Alcohol, decant, filter remainder, evaporate united liquids, make up measure with Alcohol to 100 C.c.

PRACTICAL PROCESSES FOR FLUID EXTRACTS.

EXTRACTUM ACONITI FLUIDUM. *U.S.* Fluid Extract of Aconite.

	By measure.
Aconite, in No. 60 powder, 100 grammes, or	50 oz. av.
Tartaric Acid, 1 gramme, or	½ oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *forty grammes* [or 23 fl. oz.] of Alcohol in which the Tartaric Acid has previously been dissolved, and pack it firmly in a cylindrical glass percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Aconite is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder, in a porcelain capsule, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM ARNICÆ RADICIS FLUIDUM. *U.S.* Fluid Extract of Arnica Root.

	By measure.
Arnica Root, in No. 60 powder, 100 grammes, or	50 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *forty grammes* [or 20 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Arnica Root is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM AROMATICUM FLUIDUM. *U.S.* Aromatic Fluid Extract.

	By measure.
Aromatic Powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty-five grammes* [or 20 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Aromatic Powder is exhausted. Reserve the first

eighty-five cubic centimeters [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM AURANTII AMARI FLUIDUM. *U.S.* **Fluid Extract of Bitter Orange Peel.**

	By measure.
Bitter Orange Peel, in No. 40 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *two parts* [or 4½ pints] of Alcohol with *one part* [or 2 pints] of Water, and, having moistened the powder with *thirty-five grammes* [or 19 fl. oz.] of the mixture, pack it moderately in a conical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Orange Peel is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM BELLADONNÆ FLUIDUM. *U.S.* **Fluid Extract of Belladonna.**

	By measure.
Belladonna Root, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty-five grammes* [or 20 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Belladonna Root is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM BRAYERÆ FLUIDUM. *U.S.* **Fluid Extract of Brayera.**

	By measure
Brayera, in No. 40 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *forty grammes* [or 23 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and,

having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Brayera is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate; by means of a water-bath, distil off the Alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM BUCHU FLUIDUM. *U.S.* **Fluid Extract of Buchu.**

	By measure.
Buchu, in No. 60 powder, 100 grammes, or	**50 oz. av.**
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	**3 pints.**

Mix *two parts* [or 4½ pints] of Alcohol with *one part* [or 2 pints] of Water, and, having moistened the powder with *thirty grammes* [or 1 pint] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Buchu is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM CALAMI FLUIDUM. *U.S.* **Fluid Extract of Calamus.**

	By measure.
Calamus, in No. 60 powder, 100 grammes, or	**50 oz. av.**
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	**3 pints.**

Moisten the powder with *thirty-five grammes* [or 20 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Calamus is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM CALUMBÆ FLUIDUM. *U.S.* **Fluid Extract of Calumba.**

	By measure.
Calumba, in No. 20 powder, 100 grammes, or	**50 oz. av.**
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	**3 pints.**

Moisten the powder with *thirty grammes* [or 15½ fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add

enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Calumba is exhausted. Reserve the first *seventy cubic centimeters* [or 34 fl. oz.] of the percolate; by means of a water-bath, distil off the Alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM CANNABIS INDICÆ FLUIDUM. *U.S.* **Fluid Extract of Indian Cannabis.**

	By measure.
Indian Cannabis, in No. 20 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty grammes* [or 17 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Indian Cannabis is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate; by means of a water-bath, distil off the Alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM CAPSICI FLUIDUM. *U.S.* **Fluid Extract of Capsicum.**

	By measure.
Capsicum, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *fifty grammes* [or 29 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Capsicum is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM CASTANEÆ FLUIDUM. *U.S.* **Fluid Extract of Castanea.**

	By measure.
Castanea, in No. 30 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Pour *five hundred cubic centimeters* [or 15 pints] of boiling Water upon the powder, allow it to macerate for two hours, then express the liquid, transfer the residue to a percolator, and pour Water upon it until the powder is exhausted. Evaporate the united liquids, on a water-bath, to *two hundred cubic centimeters* [or 6 pints], let cool, and add *sixty cubic centimeters* [or 29 fl. oz.] of Alcohol. When the insoluble matter has subsided, separate the clear liquid, filter the remainder, evaporate the united liquids to *eighty cubic centimeters* [or 38 fl. oz.], allow to cool, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM CHIMAPHILÆ FLUIDUM. *U.S.* **Fluid Extract of Chimaphila.**

	By measure.
Chimaphila, in No. 30 powder, 100 grammes, or	50 oz. av.
Glycerin, 10 grammes, or	3¼ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *ninety grammes* [or 46½ fl. oz.] of Diluted Alcohol. Moisten the powder with *forty grammes* [or 20 fl. oz.] of the mixture, and pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, Diluted Alcohol, until the Chimaphila is exhausted. Reserve the first *seventy cubic centimeters* [or 34 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM CHIRATÆ FLUIDUM. *U.S.* **Fluid Extract of Chirata.**

	By measure.
Chirata, in No. 30 powder, 100 grammes, or	50 oz. av.
Glycerin, 10 grammes, or	3¼ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *ninety grammes* [or 46½ fl. oz.] of Diluted Alcohol. Moisten the powder with *thirty-five grammes* [or 18 fl. oz.] of the mixture, and pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward Diluted Alcohol, until the Chirata is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate; by means of a water-bath, distil off the Alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM CIMICIFUGÆ FLUIDUM. *U.S.* **Fluid Extract of Cimicifuga.**

	By measure.
Cimicifuga, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *twenty-five grammes* [or 14½ fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Cimicifuga is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM CINCHONÆ FLUIDUM. *U.S.* **Fluid Extract of Cinchona.**

	By measure.
Yellow Cinchona, in No. 60 powder, 100 grammes, or	50 oz. av.
Glycerin, 25 grammes, or	9½ fl. oz..
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *seventy-five grammes* [or 44 fl. oz.] of Alcohol. Moisten the powder with *thirty-five grammes* [or 18 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator, and pour on the remainder of the menstruum. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, and, when the liquid in the percolator has disappeared from the surface, gradually pour on a mixture of Alcohol and Water, made in the proportion of *three parts* [or 3¼ pints] of Alcohol to *one part* [or 1 pint] of Water, and continue the percolation until the Cinchona is exhausted. Reserve the first *seventy-five cubic centimeters* [or 36 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of Alcohol and Water, using the same proportions as before, to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM COLCHICI RADICIS FLUIDUM. *U.S.* **Fluid Extract of Colchicum Root.**

	By measure.
Colchicum Root, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *two parts* [or 4¼ pints] of Alcohol, with *one part* [or 2 pints] of Water, and, having moistened the powder with *thirty-five grammes*

[or 20 fl. oz.] of the mixture, pack it moderately in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Colchicum Root is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM COLCHICI SEMINIS FLUIDUM. *U.S.* **Fluid Extract of Colchicum Seed.**

	By measure.
Colchicum Seed, in No. 30 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *two parts* [or 4½ pints] of Alcohol with *one part* [or 2 pints] of Water, and, having moistened the powder with *thirty grammes* [or 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator, then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Colchicum Seed is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM CONII FLUIDUM. *U.S.* **Fluid Extract of Conium.**

	By measure.
Conium, (Fruit) in No. 40 powder, 100 grammes, or	50 oz. av.
Diluted Hydrochloric Acid, 3 grammes, or	1½ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty grammes* [or 15½ fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Conium is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and, having added the Diluted Hydrochloric Acid to the remainder, evaporate it, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM CORNUS FLUIDUM. *U. S.* **Fluid Extract of Cornus.**

	By measure.
Cornus, in No. 60 powder, 100 grammes, or	50 oz. av.
Glycerin, 20 grammes, or	7½ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *eighty grammes* [or 41 fl. oz.] of Diluted Alcohol. Moisten the powder with *thirty grammes* [or 15 fl. oz.] of the mixture, and pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, Diluted Alcohol, until the Cornus is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM CUBEBÆ FLUIDUM. *U. S.* **Fluid Extract of Cubeb.**

	By measure.
Cubeb, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *twenty-five grammes* [or 14½ fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Cubeb is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM CYPRIPEDII FLUIDUM. *U. S.* **Fluid Extract of Cypripedium.**

	By measure.
Cypripedium, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty-five grammes* [or 20 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Cypripedium is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the re-

mainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM DIGITALIS FLUIDUM. *U.S.* **Fluid Extract of Digitalis.**

	By measure.
Digitalis, recently dried and in No. 60 powder, 100 grammes, or	**50 oz. av.**
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	**3 pints.**

Mix *three parts* [or 3½ pints] of Alcohol with *one part* [or 1 pint] of Water, and, having moistened the powder with *thirty-five grammes* [or 20 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Digitalis is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM DULCAMARÆ FLUIDUM. *U.S.* **Fluid Extract of Dulcamara.**

	By measure.
Dulcamara, in No 60 powder, 100 grammes, or	**50 oz. av.**
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	**3 pints.**

Moisten the powder with *forty grammes* [or 20 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Dulcamara is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM ERGOTÆ FLUIDUM. *U.S.* **Fluid Extract of Ergot.**

	By measure.
Ergot, recently ground and in No. 60 powder, 100 grammes, or	**50 oz. av.**
Diluted Hydrochloric Acid, 6 grammes, or	**3 fl. oz.**
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	**3 pints.**

Mix *three parts* [or 2½ pints] of Alcohol with *four parts* [or 2¾ pints] of Water, and, having moistened the powder with *thirty grammes* [or 15½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave

a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Ergot is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and, having added the Diluted Hydrochloric Acid to the remainder, evaporate to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM ERYTHROXYLI FLUIDUM. *U.S.* **Fluid Extract of Erythroxylon.**

	By measure.
Erythroxylon, in No. 40 powder, 100 grammes, or	50 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *forty-five grammes* [or 23½ fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Erythroxylon is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM EUCALYPTI FLUIDUM. *U.S.* **Fluid Extract of Eucalyptus.**

	By measure
Eucalyptus, in No. 40 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty-five grammes* [or 20 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Eucalyptus is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM EUPATORII FLUIDUM. *U.S.* **Fluid Extract of Eupatorium.**

	By measure.
Eupatorium, in No. 40 powder, 100 grammes, or	50 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *forty grammes* [or 20 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add

enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Eupatorium is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM FRANGULÆ FLUIDUM. *U.S.* **Fluid Extract of Frangula.**

	By measure.
Frangula, in No. 40 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *one part* [or 2½ pints] of Alcohol with *two parts* [or 4 pints] of Water, and, having moistened the powder with *thirty-five grammes* [or 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Frangula is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM GELSEMII FLUIDUM. *U.S.* **Fluid Extract of Gelsemium.**

	By measure.
Gelsemium, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty grammes* [or 17 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Gelsemium is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM GENTIANÆ FLUIDUM. *U.S.* **Fluid Extract of Gentian.**

	By measure.
Gentian, in No. 30 powder, 100 grammes, or	50 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty-five grammes* [or 18 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Gentian is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate. By means of a water-bath, distil off the Alcohol from the remainder and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM GERANII FLUIDUM. *U.S.* **Fluid Extract of Geranium.**

	By measure.
Geranium, in No. 30 powder, 100 grammes, or	50 oz. av.
Glycerin, 10 grammes, or	3¼ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *ninety grammes* [or 46½ fl. oz.] of Diluted Alcohol, and, having moistened the powder with *thirty-five grammes* [or 18 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, Diluted Alcohol, until the Geranium is exhausted. Reserve the first *seventy cubic centimeters* [or 34 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM GLYCYRRHIZÆ FLUIDUM. *U.S.* **Fluid Extract of Glycyrrhiza.**

	By measure.
Glycyrrhiza, in No. 40 powder, 100 grammes, or	50 oz. av.
Water of Ammonia,	
Diluted Alcohol, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *three parts* [or 3 fl. oz.] of Water of Ammonia with *ninety-seven parts* [or 6¼ pints] of Diluted Alcohol, and, having moistened the powder with *thirty-five grammes* [or 18 fl. oz.] of the mixture, pack it firmly in a cylindrical glass percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Glycyrrhiza is exhausted. Reserve the first *seventy-five cubic centimeters* [or 36 fl. oz.] of the percolate, and, having added *three grammes* [or 1½ fl. oz.] of Water of Ammonia to the remainder, evaporate to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM GOSSYPII RADICIS FLUIDUM. *U.S.* **Fluid Extract of Cotton Root.**

	By measure.
Cotton Root, in No. 30 powder, 100 grammes, or	50 oz. av.
Glycerin, 35 grammes, or	13½ fl. oz.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *sixty-five grammes* [or 38 fl. oz.] of Alcohol, and, having moistened the powder with *fifty grammes* [or 26 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator, and pour on the remainder of the menstruum. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, and, when the liquid in the percolator has disappeared from the surface, gradually pour on Alcohol, and continue the percolation until the Cotton Root is exhausted. Reserve the first *seventy cubic centimeters* [or 33½ fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM GRINDELIÆ FLUIDUM. *U.S.* **Fluid Extract of Grindelia.**

	By measure.
Grindelia, in No. 30 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *three parts* [or 3 pints 6 fl. oz.] of Alcohol with *one part* [or 1 pint] of Water, and, having moistened the powder with *thirty grammes* [or 17½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Grindelia is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM GUARANÆ FLUIDUM. *U.S.* **Fluid Extract of Guarana.**

	By measure.
Guarana, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *three parts* [or 3 pints 6 fl. oz.] of Alcohol with *one part* [or 1 pint] of Water, and, having moistened the powder with *twenty grammes* [or 12 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator,

macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Guarana is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate. By means of a water-bath, distil off the Alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM HAMAMELIDIS FLUIDUM. *U.S.* **Fluid Extract of Hamamelis.**

	By measure.
Hamamelis, in No. 40 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *one part* [or 2½ pints] of Alcohol with *two parts* [or 4 pints] of Water, and, having moistened the powder with *thirty-five grammes* [or 18 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Hamamelis is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM HYDRASTIS FLUIDUM. *U.S.* **Fluid Extract of Hydrastis.**

	By measure.
Hydrastis, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *three parts* [or 3 pints 6 fl. oz.] of Alcohol with *one part* [or 1 pint] of Water, and, having moistened the powder with *thirty grammes* [or 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Hydrastis is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate. By means of a water-bath, distil off the Alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM HYOSCYAMI FLUIDUM. *U.S.* **Fluid Extract of Hyoscyamus.**

	By measure.
Hyoscyamus, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *three parts* [or 3 pints 6 fl. oz.] of Alcohol with *one part* [or 1 pint] of Water, and, having moistened the powder with *forty grammes* [or 23 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Hyoscyamus is exhausted. Reserve the first *ninety cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM IPECACUANHÆ FLUIDUM. *U.S.* **Fluid Extract of Ipecac.**

	By measure.
Ipecac, in No. 80 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty-five grammes* [or 20 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed until the Ipecac is exhausted. By means of a water-bath, distil off the Alcohol from the tincture until the residue measures *fifty cubic centimeters* [or 1½ pints], and add to it *one hundred cubic centimeters* [or 3 pints] of Water. Evaporate the mixture to *seventy-five cubic centimeters* [or 2½ pints], and, when cool, filter. Wash the precipitate upon the filter, with Water, until the latter passes through tasteless, evaporate the filtrate and washings to *fifty cubic centimeters* [or 1½ pints], allow to cool, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM IRIDIS FLUIDUM. *U.S.* **Fluid Extract of Iris.**

	By measure.
Iris, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *three parts* [or 3 pints 6 fl. oz.] of Alcohol with *one part* [or 1 pint] of Water, and, having moistened the powder with *forty grammes* [or 23 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Iris is exhausted. Reserve the first *ninety cubic centimeters* [or 40 fl. oz.] of the percolate,

and evaporate the remainder, on a water-bath, to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM KRAMERIÆ FLUIDUM. *U.S.* **Fluid Extract of Krameria.**

	By measure.
Krameria, in No. 30 powder, 100 grammes, or	50 oz. av.
Glycerin, 20 grammes, or	7½ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *eighty grammes* [or 41 fl. oz.] of Diluted Alcohol, and, having moistened the powder with *forty grammes* [or 20 fl. oz.] of the mixture, pack it firmly in a cylindrical glass percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, Diluted Alcohol, until the Krameria is exhausted. Reserve the first *seventy cubic centimeters* [or 33 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM LACTUCARII FLUIDUM. *U.S.* **Fluid Extract of Lactucarium.**

	By measure.
Lactucarium, in coarse pieces, 100 grammes, or	12½ oz. av.
Ether, 100 grammes, or	1 pint.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	12 fl. oz.

Add the Lactucarium to the Ether contained in a tared flask having the capacity of *six hundred cubic centimeters* [or about 4½ pints], and let it macerate for twenty-four hours; then add *three hundred grammes* [or 2½ pints] of Water, and shake the mixture well. Fit a bent glass tube into the neck of the flask, and, having immersed the flask in hot water, recover the Ether by distillation. When all the Ether has distilled over, remove the tube, and, after thoroughly shaking the contents of the flask, continue the heat for half an hour. Let the mixture cool, add *one hundred grammes* [or 14½ fl. oz.] of Alcohol, and enough Water to make the whole mixture weigh *five hundred grammes* [or 64 oz. av.]; after maceration for twenty-four hours, with occasional agitation, express and filter the liquid. Return the dregs to the flask and macerate them with *two hundred grammes* [or 28 fl. oz.] of a mixture of Alcohol and Water made in the proportion of *one part* [or 8 fl. oz.] of Alcohol to *three parts* [or 20 fl. oz.] of Water; repeat the maceration two or three times, successively, with fresh portions of the mixture, until the dregs are tasteless, or nearly so. Mix, and filter the liquids thus obtained, and concentrate them, by means of a water-bath (the first expressed liquid by itself), until the combined weight of the liquids is *sixty grammes* [or 7½ oz. av.]; mix the liquids, add *forty grammes* [or 6 fl. oz.] of Alcohol, and let the mixture cool in the evap-

orating vessel, stirring the mixture frequently, and during the intervals keeping the vessel well covered. When cool, add enough Alcohol to make the mixture weigh *one hundred grammes* [or 12¼ oz. av.], transfer the liquid to a flask, and add enough Water to make the mixture measure *one hundred cubic centimeters* [or 12 fl. oz.], using the Water so required to rinse the evaporating vessel. Shake the mixture occasionally, during several hours (and frequently, if a portion of the precipitate is found to be tenacious), and, when a uniform mixture results, set it aside for twenty-four hours, so that any precipitate formed may subside. Decant the clear liquid, transfer the precipitate to a filter, and, after thoroughly draining it into the decanted liquid, wash it with a mixture of Alcohol and Water made in the proportion of *three parts* [or 10 fl. dr.] of Alcohol to *four parts* [or 11 fl. dr.] of Water, until the washings pass tasteless. Concentrate the washings, by evaporation, to a syrupy consistence, mix with the decanted liquid, and add enough of the last-named mixture of Alcohol and Water to make the whole measure *one hundred cubic centimeters* [or 12 fl. oz.]. Lastly, after twenty-four hours, having meanwhile shaken the Fluid Extract occasionally, filter it through paper.

EXTRACTUM LEPTANDRÆ FLUIDUM. *U.S.* **Fluid Extract of Leptandra.**

	By measure.
Leptandra, in No. 60 powder, 100 grammes, or	50 oz. av.
Glycerin, 15 grammes, or	5½ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *eighty-five grammes* [or 44 fl. oz.] of Diluted Alcohol, and, having moistened the powder with *forty grammes* [or 23 fl. oz.] of the mixture, pack moderately in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, Diluted Alcohol, until the Leptandra is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM LOBELIÆ FLUIDUM. *U.S.* **Fluid Extract of Lobelia.**

	By measure.
Lobelia, in No. 60 powder, 100 grammes, or	50 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty-five grammes* [or 18 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Lobelia is exhausted. Reserve the first

eighty-five cubic centimeters [or 40 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM LUPULINI FLUIDUM. *U.S.* **Fluid Extract of Lupulin.**

	By measure.
Lupulin, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the Lupulin with *twenty grammes* [or 12 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the Lupulin and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Lupulin is exhausted. Reserve the first *seventy cubic centimeters* [or 33 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM MATICO FLUIDUM. *U.S.* **Fluid Extract of Matico.**

	By measure.
Matico, in No. 40 powder, 100 grammes, or	50 oz. av.
Glycerin, 10 grammes, or	3¼ fl. oz.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *seventy-five grammes* [or 44 fl. oz.] of Alcohol and *twenty-five grammes* [or 12 fl. oz.] of Water, and, having moistened the powder with *thirty grammes* [or 15 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, a mixture of Alcohol and Water, made in the proportion of *three parts* [or 3¼ pints] of Alcohol to *one part* [or 1 pint] of Water, until the Matico is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of Alcohol and Water, using the same proportions as before, to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM MEZEREI FLUIDUM. *U.S.* **Fluid Extract of Mezereum.**

	By measure.
Mezereum, in No. 80 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *forty grammes* [or 23 fl. oz.] of Alcohol,

and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Mezereum is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM NUCIS VOMICÆ FLUIDUM. *U.S.* **Fluid Extract of Nux Vomica.**

	By measure.
Nux Vomica, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *eight parts* [or 9 pints] of Alcohol with *one part* [or 1 pint] of Water, and, having moistened the powder with *one hundred cubic centimeters* [or 3 pints] of the mixture, let it macerate in a closed vessel, in a warm place, for forty-eight hours. Then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it, until the tincture passes but slightly imbued with bitterness. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate. By means of a water-bath, distil off the Alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints.]

EXTRACTUM PAREIRÆ FLUIDUM. *U.S.* **Fluid Extract of Pareira.**

	By measure.
Pareira, in No. 40 powder, 100 grammes, or	50 oz.
Glycerin, 20 grammes, or	7½ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *eighty grammes* [or 41 fl. oz.] of Diluted Alcohol, and, having moistened the powder with *forty grammes* [or 20 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, Diluted Alcohol, until the Pareira is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate. By means of a water-bath, distil off the Alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM PILOCARPI FLUIDUM. *U.S.* **Fluid Extract of Pilocarpus.**

	By measure.
Pilocarpus, in No. 40 powder, 100 grammes, or	50 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty-five grammes* [or 18 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Pilocarpus is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM PODOPHYLLI FLUIDUM. *U.S.* **Fluid Extract of Podophyllum.**

	By measure.
Podophyllum, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *three parts* [or 3½ pints] of Alcohol with *one part* [or 1 pint] of Water, and, having moistened the powder with *thirty grammes* [or 1 pint] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Podophyllum is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate; by means of a water-bath, distil off the Alcohol from the remainder; dissolve the residue in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM PRUNI VIRGINIANÆ FLUIDUM. *U.S.* **Fluid Extract of Wild Cherry.**

	By measure.
Wild Cherry, in No. 20 powder, 100 grammes, or	50 oz. av.
Diluted Alcohol,	
Glycerin,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *two parts* [or 17 fl. oz.] of Water with *one part* [or 7 fl. oz.] of Glycerin, and, having moistened the powder with *fifty grammes* [or 24 fl. oz.] of the mixture, pack it loosely in a cylindrical percolator, cover the latter well, and set it aside for forty-eight hours. Then pack the

damp powder firmly in the percolator, and pour on enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Wild Cherry is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate and set it aside; collect the next *one hundred and twenty cubic centimeters* [or 57 fl. oz.] separately, and evaporate to a thin syrup. By means of a water-bath, distil off the Alcohol from the remainder of the percolate, and evaporate the residue to a thin syrup. Unite the two syrupy liquids, and evaporate them, on a water-bath, to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM QUASSIÆ FLUIDUM. *U.S.* **Fluid Extract of Quassia.**

	By measure.
Quassia, in No. 60 powder, 100 grammes, or	50 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *forty grammes* [or 20 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Quassia is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM RHEI FLUIDUM. *U.S.* **Fluid Extract of Rhubarb.**

	By measure.
Rhubarb, in No. 30 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *three parts* [or 3½ pints] of Alcohol with *one part* [or 1 pint] of Water, and, having moistened the powder with *forty grammes* [or 1 pint] of the mixture, pack it firmly in a conical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Rhubarb is exhausted. Reserve the first *seventy-five cubic centimeters* [or 36 fl. oz.] of the percolate, and evaporate the remainder, at a temperature not exceeding 70° C. (158° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM RHOIS GLABRÆ FLUIDUM. *U. S.* **Fluid Extract of Rhus Glabra.**

	By measure.
Rhus Glabra, in No. 40 powder, 100 grammes, or	50 oz. av.
Glycerin, 10 grammes, or	3¼ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *ninety grammes* [or 46½ fl. oz.] of Diluted Alcohol, and, having moistened the powder with *thirty-five grammes* [or 18 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, Diluted Alcohol, until the Rhus Glabra is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM ROSÆ FLUIDUM. *U. S.* **Fluid Extract of Rose.**

	By measure.
Red Rose, in No. 30 powder, 100 grammes, or	50 oz. av.
Glycerin, 10 grammes, or	3¼ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *ninety grammes* [or 46½ fl. oz.] of Diluted Alcohol, and, having moistened the powder with *forty grammes* [or 20 fl. oz.] of the mixture, pack it firmly in a cylindrical glass percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, Diluted Alcohol, until the Red Rose is exhausted. Reserve the first *seventy-five cubic centimeters* [or 36 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM RUBI FLUIDUM. *U. S.* **Fluid Extract of Rubus.**

	By measure.
Rubus, in No. 60 powder, 100 grammes, or	50 oz. av.
Glycerin, 20 grammes, or	7½ fl. oz.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *forty-five grammes* [or 26 fl. oz.] of Alcohol and *thirty-five grammes* [or 1 pint] of Water, and, having moistened the powder with *thirty-five grammes* [or 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the men-

struum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, a mixture of Alcohol and Water, made in the proportion of *nine parts* [or 26 fl. oz.] of Alcohol to *seven parts* [or 1 pint] of Water, until the Rubus is exhausted. Reserve the first *seventy cubic centimeters* [or 33 fl. oz.] of the percolate; by means of a water-bath, distil off the Alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of Alcohol and Water, using the last-named proportions, to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM RUMICIS FLUIDUM. *U.S.* **Fluid Extract of Rumex.**

	By measure.
Rumex, in No. 40 powder, 100 grammes, or	50 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty-five grammes* [or 18 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Rumex is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM SABINÆ FLUIDUM. *U.S.* **Fluid Extract of Savine.**

	By measure.
Savine, in No. 40 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *twenty-five grammes* [or 15 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Savine is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM SANGUINARIÆ FLUIDUM. *U.S.* **Fluid Extract of Sanguinaria.**

	By measure.
Sanguinaria, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty grammes* [or 17 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Sanguinaria is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM SARSAPARILLÆ COMPOSITUM FLUIDUM. *U.S.*

Compound Fluid Extract of Sarsaparilla.

	By measure.
Sarsaparilla, in No. 30 powder, 75 grammes, or	37½ oz. av.
Glycyrrhiza, in No. 30 powder, 12 grammes, or	6 oz. av.
Sassafras, in No. 30 powder, 10 grammes, or	5 oz. av.
Mezereum, in No. 30 powder, 3 grammes, or	1½ oz. av.
Glycerin, 10 grammes, or	3¼ fl. oz.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *thirty grammes* [or 17 fl. oz.] of Alcohol and *sixty grammes* [or 30 fl. oz.] of Water, and, having moistened the mixed powders with *forty grammes* [or 20 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, a mixture of Alcohol and Water, made in the proportion of *one part* [or 2½ pints] of Alcohol to *two parts* [or 4 pints] of Water, until the powder is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of Alcohol and Water, using the last-named proportions, to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM SARSAPARILLÆ FLUIDUM. *U.S.* **Fluid Extract of Sarsaparilla.**

	By measure.
Sarsaparilla, in No. 30 powder, 100 grammes, or	50 oz. av.
Glycerin, 10 grammes, or	3¼ fl. oz.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *thirty grammes* [or 17 fl. oz.] of Alcohol and *sixty grammes* [or 30 fl. oz.] of Water, and, having moistened the powder with *forty grammes* [or 20 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely

covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, a mixture of Alcohol and Water, made in the proportion of *one part* [or 2½ pints] of Alcohol to *two parts* [or 4 pints] of Water, until the Sarsaparilla is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of Alcohol and Water, using the last-named proportions, to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM SCILLÆ FLUIDUM. *U.S.* **Fluid Extract of Squill.**

	By measure.
Squill, in No. 20 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *twenty grammes* [or 12 fl. oz.] of Alcohol, and pack it in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Squill is exhausted. Reserve the first *seventy-five cubic centimeters* [or 36 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM SCUTELLARIÆ FLUIDUM. *U.S.* **Fluid Extract of Scutellaria.**

	By measure.
Scutellaria, in No. 40 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *one part* [or 2½ pints] of Alcohol with *two parts* [or 4 pints] of Water, and, having moistened the powder with *thirty-five grammes* [or 1 pint] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Scutellaria is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM SENEGÆ FLUIDUM. *U.S.* **Fluid Extract of Senega.**

	By measure.
Senega, in No. 40 powder, 100 grammes, or	50 oz. av.
Water of Ammonia, 2 grammes, or	1 fl. oz.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *two parts* [or 4½ pints] of Alcohol with *one part* [or 2 pints] of Water, and, having moistened the powder with *forty-five grammes* [or 26 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Senega is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add, first, the Water of Ammonia, and afterward, enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM SENNÆ FLUIDUM. *U.S.* **Fluid Extract of Senna.**

	By measure.
Senna, in No. 30 powder, 100 grammes, or	**50 oz. av.**
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	**3 pints.**

Mix *three parts* [or 3 pints 6 fl. oz.] of Alcohol with *four parts* [or 4 pints] of Water, and, having moistened the powder with *forty grammes* [or 20 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Senna is exhausted. Reserve the first *eighty cubic centimeters* [or 38 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM SERPENTARIÆ FLUIDUM. *U.S.* **Fluid Extract of Serpentaria.**

	By measure.
Serpentaria, in No. 60 powder, 100 grammes, or	**50 oz. av.**
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	**3 pints.**

Mix *three parts* [or 3 pints 6 fl. oz.] of Alcohol with *one part* [or 1 pint] of Water, and, having moistened the powder with *thirty grammes* [or 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Serpentaria is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM SPIGELIÆ FLUIDUM. *U.S.* Fluid Extract of Spigelia.

	By measure.
Spigelia, in No. 60 powder, 100 grammes, or	50 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty grammes* [or 15 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Spigelia is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM STILLINGIÆ FLUIDUM. *U.S.* Fluid Extract of Stillingia.

	By measure.
Stillingia, in No. 40 powder, 100 grammes, or	50 oz. av.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty grammes* [or 15 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until the Stillingia is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM STRAMONII FLUIDUM. *U.S.* Fluid Extract of Stramonium.

	By measure.
Stramonium Seed, in No. 40 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *three parts* [or 3 pints 6 fl. oz.] of Alcohol with *one part* [or 1 pint] of Water, and, having moistened the powder with *twenty grammes* [or 12 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Stramonium Seed is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of

the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM TARAXACI FLUIDUM. *U.S.* **Fluid Extract of Taraxacum.**

	By measure.
Taraxacum, in No. 30 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *two parts* [or 4½ pints] of Alcohol with *three parts* [or 6 pints] of Water, and, having moistened the powder with *thirty grammes* [or 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Taraxacum is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate; by means of a water-bath, distil off the Alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM TRITICI FLUIDUM. *U.S.* **Fluid Extract of Triticum.**

	By measure.
Triticum, finely cut, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Pack the Triticum in a cylindrical percolator, and pour Boiling Water upon it until it is exhausted. Evaporate the percolate to *eighty cubic centimeters* [or 38 fl. oz.], and, having added to it *twenty cubic centimeters* [or 10 fl. oz.] of Alcohol, mix well, and set it aside for forty-eight hours. Then filter the liquid and add to the filtrate enough of a mixture composed of *four parts* [or 4 fl. oz.] of Water and *one part* [or 1¼ fl. oz.] of Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM UVÆ URSI FLUIDUM. *U.S.* **Fluid Extract of Uva Ursi.**

	By measure.
Uva Ursi, in No. 30 powder, 100 grammes, or	50 oz. av.
Glycerin, 10 grammes, or	3¼ fl. oz.
Diluted Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix the Glycerin with *ninety grammes* [or 46 fl. oz.] of Diluted Alcohol, and, having moistened the powder with *thirty-five grammes* [or 18 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator,

macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, Diluted Alcohol, until the Uva Ursi is exhausted. Reserve the first *seventy cubic centimeters* [or 33 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Diluted Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM VALERIANÆ FLUIDUM. *U.S.* **Fluid Extract of Valerian.**

	By measure.
Valerian, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *two parts* [or 4½ pints] of Alcohol with *one part* [or 2 pints] of Water, and, having moistened the powder with *thirty grammes* [or 17 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Valerian is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM VERATRI VIRIDIS FLUIDUM. *U.S.* **Fluid Extract of Veratrum Viride.**

	By measure.
Veratrum Viride, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *thirty grammes* [or 17 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Veratrum Viride is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM VIBURNI FLUIDUM. *U.S.* **Fluid Extract of Viburnum.**

	By measure.
Viburnum, in No. 60 powder, 100 grammes, or	50 oz. av.
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Mix *two parts* [or 4½ pints] of Alcohol with *one part* [or 2 pints] of Water, and, having moistened the powder with *thirty grammes* [or 17 fl. oz.] of the mixture, pack it moderately in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Viburnum is exhausted. Reserve the first *eighty-five cubic centimeters* [or 40 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM XANTHOXYLI FLUIDUM. *U.S.* **Fluid Extract of Xanthoxylum.**

	By measure.
Xanthoxylum, in No. 40 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *twenty-five grammes* [or 14 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Xanthoxylum is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

EXTRACTUM ZINGIBERIS FLUIDUM. *U.S.* **Fluid Extract of Ginger.**

	By measure.
Ginger, in No. 40 powder, 100 grammes, or	50 oz. av.
Alcohol, a sufficient quantity,	
To make 100 cubic centimeters, or	3 pints.

Moisten the powder with *twenty-five grammes* [or 14 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Ginger is exhausted. Reserve the first *ninety cubic centimeters* [or 43 fl. oz.] of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough Alcohol to make the Fluid Extract measure *one hundred cubic centimeters* [or 3 pints].

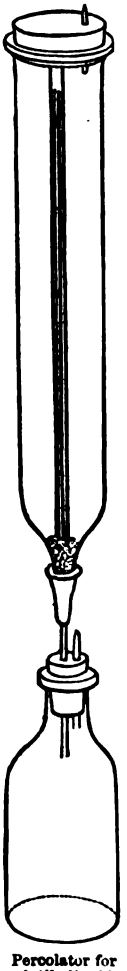
CHAPTER XXVIII.

ETHEREAL LIQUIDS MADE BY PERCOLATION.

Oleoresinæ. *Oleoresins.*

THE oleoresins are officinal liquid preparations, consisting principally of natural oils and resins extracted from vegetable substances by percolation with stronger ether. The oleoresins were formerly classed with fluid extracts, but they differ essentially from the latter: 1. They do not bear any uniform relation to the drug, as the fluid extracts do, of gramme to cubic centimetre,—the yield of oleoresin obtained from the drug varying according to the proportion of oil and resin naturally present. 2. The menstruum used, stronger ether, extracts principles which are often insoluble in alcohol or in diluted alcohol, and *vice versa*. Oleoresin of cubeb, for instance, is not identical in properties with fluid extract of cubeb. 3. They are without exception the most concentrated liquid preparations of the drugs that are produced.

FIG. 330.



Percolator for volatile liquids.

Oleoresins are prepared by percolating the powdered drug, contained in a cylindrical percolator provided with a cover and receptacle suitable for volatile liquids, with stronger ether, until exhausted, recovering the greater part of the ether by distillation, and exposing the residue in a capsule to spontaneous evaporation until the remaining ether has evaporated. Fig. 330 shows a convenient percolator for making oleoresins. The powder should not be packed too tightly in the narrow percolator: the exit-tube affords a means of easily regulating the flow. A *continuous extraction apparatus* can be made of this percolator by enclosing the upper part in a suitable case and passing cold water between, arranging the apparatus like a Liebig's condenser (see page 128). A glass tube is connected with the top of the percolator and the mouth of the bottle by rubber-tube connections, and if the receiving-bottle is placed in a water-bath and the water gently heated, the ether will evaporate from the percolate, the vapors rising in the tube and condensing in the upper part of the percolator.

Oleoresins which have not been evaporated sufficiently are frequently found in commerce: they have a decided odor of ether, and sometimes of benzin, showing in the latter case that a menstruum which is a much inferior solvent has been substituted for the one authorized by the Pharmacopœia. Six oleoresins are officinal.

Table of Officinal Oleoresins.

Name.	Yield.	Dose.
Oleoresina Aspidii.	10 to 15 per cent.	ʒss to ʒi.
" Capsici.	5 per cent.	♏ ¼ to ♏i.
" Cubebæ.	18 to 25 per cent.	♏v to ♏xxx.
" Lupulini.	50 per cent.	♏ij to ♏v.
" Piperis.	5 per cent.	♏ ¼ to ♏i.
" Zingiberis.	6 to 8 per cent.	♏i.

OLEORESINA ASPIDII. *U.S.* Oleoresin of Aspidium.

[OLEORESINA FILICIS, *Pharm.* 1870.]

	By measure.
Aspidium, in No. 60 powder, 100 parts, or	16 oz. av.
Stronger Ether, a sufficient quantity,	
To make . . . . . about	2 fl. oz.

Put the Aspidium into a cylindrical glass percolator, provided with a cover and receptacle suitable for volatile liquids, press it firmly, and gradually pour Stronger Ether upon it, until *one hundred and fifty parts* [or 2 pints] of liquid have slowly passed. Recover the greater part of the Ether by distillation on a water-bath, and expose the residue, in a capsule, until the remaining Ether has evaporated.

Keep the Oleoresin in a well-stopped bottle.

Note.—Oleoresin of Aspidium usually deposits, on standing, a granular-crystalline substance. This should be thoroughly mixed with the liquid portion, before use.

OLEORESINA CAPSICI. *U.S.* Oleoresin of Capsicum.

	By measure.
Capsicum, in No. 60 powder, 100 parts, or	32 oz. av.
Stronger Ether, a sufficient quantity,	
To make . . . . . about	1½ fl. oz.

Put the Capsicum into a cylindrical percolator, provided with a cover and receptacle suitable for volatile liquids, press it firmly, and gradually pour Stronger Ether upon it, until *one hundred and fifty parts* [or 4 pints] of liquid have slowly passed. Recover the greater part of the Ether by distillation on a water-bath, and expose the residue, in a capsule, until the remaining Ether has evaporated. Lastly, pour off the liquid portion, transfer the remainder to a strainer, and, when the separated fatty matter (which is to be rejected) has been completely drained, mix all the liquid portions together.

Keep the Oleoresin in a well-stopped bottle.

OLEORESINA CUBEBÆ. *U.S.* Oleoresin of Cubeb.

	By measure.
Cubeb, in No. 60 powder, 100 parts, or	16 oz. av.
Stronger Ether, a sufficient quantity,	
To make . . . . . about	4 fl. oz.

Put the Cubeb into a cylindrical percolator, provided with a cover and receptacle suitable for volatile liquids, press it firmly, and gradu-

ally pour Stronger Ether upon it, until *one hundred and fifty parts* [or 2 pints] of liquid have slowly passed. Recover the greater part of the Ether by distillation on a water-bath, and expose the residue, in a capsule, until the remaining Ether has evaporated. Transfer the remainder to a close vessel, and let it stand until it ceases to deposit a waxy and crystalline matter. Lastly, pour off the Oleoresin.

Keep the Oleoresin in a well-stopped bottle.

OLEORESINA LUPULINI. *U.S.* Oleoresin of Lupulin.

[OLEORESINA LUPULINÆ, *Pharm.* 1870.]

	By measure.
Lupulin, 100 parts, or	16 oz. av.
Stronger Ether, a sufficient quantity,	
To make about	8 fl. oz.

Put the Lupulin into a narrow, cylindrical percolator, provided with a cover and receptacle suitable for volatile liquids, press it firmly, and gradually pour Stronger Ether upon it, until *one hundred and fifty parts* [or 2 pints] of liquid have slowly passed. Recover the greater part of the Ether by distillation on a water-bath, and expose the residue, in a capsule, until the remaining Ether has evaporated.

Keep the Oleoresin in a well-stopped, wide-mouthed bottle.

OLEORESINA PIPERIS. *U.S.* Oleoresin of Pepper.

	By measure.
Pepper, in No. 60 powder, 100 parts, or	32 oz. av.
Stronger Ether, a sufficient quantity,	
To make about	1½ fl. oz.

Put the Pepper into a cylindrical percolator, provided with a cover and receptacle suitable for volatile liquids, press it firmly, and gradually pour Stronger Ether upon it, until *one hundred and fifty parts* [or 4 pints] of liquid have slowly passed. Recover the greater part of the Ether by distillation on a water-bath, and expose the residue, in a capsule, until the remaining Ether has evaporated, and the deposition of piperine, in crystals, has ceased. Lastly, separate the Oleoresin from the piperine by expression through a muslin strainer.

Keep the Oleoresin in a well-stopped bottle.

OLEORESINA ZINGIBERIS. *U.S.* Oleoresin of Ginger.

	By measure.
Ginger, in No. 60 powder, 100 parts, or	16 oz. av.
Stronger Ether, a sufficient quantity,	
To make about	1 fl. oz.

Put the Ginger into a cylindrical percolator, provided with a cover and receptacle suitable for volatile liquids, press it firmly, and gradually pour Stronger Ether upon it, until *one hundred and fifty parts* [or 2 pints] of liquid have slowly passed, or until the Ginger is exhausted. Recover the greater part of the Ether by distillation on a water-bath, and expose the residue, in a capsule, until the remaining Ether has evaporated.

Keep the Oleoresin in a well-stopped bottle.

CHAPTER XXIX.

ACETOUS LIQUIDS MADE BY PERCOLATION.

Aceta. *Vinegars.*

THIS class of preparations is an old one, having been in use since the days of Hippocrates. Medicated vinegars are solutions of the active principles of drugs in diluted acetic acid, the latter being chosen as a menstruum because acetic acid is not only a good solvent but also possesses antiseptic properties.

Diluted acetic acid replaces the menstrua formerly used, wine and cider vinegar having been discarded on account of their variable quality. Acetic acid may be obtained in all parts of the country very cheaply and of unexceptionable quality, and by simple admixture with seven times its weight of water the menstruum is produced. The properties of acetic acid are noticed in Part IV. of this work.

Four vinegars are officinal at present: three are made from drugs which owe their activity to alkaloids. The advantage of using acidulous menstruum is apparent in forming soluble salts with the alkaloids, and experience has proved the value of diluted acetic acid as a solvent in exhausting drugs of this character. The medicated vinegars should not be made in larger quantities than can be used within a reasonable time, for, although possessed of most of the characters of permanent preparations, they are liable to deposit in time.

The officinal vinegars are now uniform in strength, each containing the soluble principles from ten per cent. of drug. They are all made by percolation.

Table of Officinal Vinegars.

Name.	Proportions.
Acetum Lobeliæ . . .	10 p. Lobelia, No. 30 powder, with sufficient Diluted Acetic Acid to make 100 parts.
" Opii	10 p. Powdered Opium; 3 p. Powdered Nutmeg; 20 p. Sugar, with sufficient Diluted Acetic Acid to make 100 parts.
" Sanguinariæ .	10 p. Sanguinaria, No. 30 powder, with sufficient Diluted Acetic Acid to make 100 parts.
" Scillæ. . . .	10 p. Squill, No. 30 powder, with sufficient Diluted Acetic Acid to make 100 parts.

ACETUM LOBELIÆ. *U.S.* **Vinegar of Lobelia.**

	By measure.
Lobelia, in No. 30 powder, 10 parts, or	1¼ oz. av.
Diluted Acetic Acid, a sufficient quantity,	
To make 100 parts, or	1 pint.

Moisten the powder with *five parts* [or 1 fl. oz.] of Diluted Acetic

Acid, pack it firmly in a conical glass percolator, and gradually pour Diluted Acetic Acid upon it until *one hundred parts* [or 1 pint] of filtered liquid are obtained.

ACETUM OPII. *U.S.* Vinegar of Opium.

	By measure.
Powdered Opium, 10 parts, or	2 oz. av.
Nutmeg, in No. 30 powder, 3 parts, or	260 grains.
Sugar, 20 parts, or	4 oz. av.
Diluted Acetic Acid, a sufficient quantity,	
To make 100 parts, or	18 fl. oz.

Macerate the Opium and Nutmeg in *fifty parts* [or 9 fl. oz.] of Diluted Acetic Acid for twenty-four hours. Put the mixture into a conical glass percolator and return the percolate until it passes clear. Then gradually pour on Diluted Acetic Acid until *eighty parts* [or 1 pint] of liquid are obtained. In this dissolve the Sugar by agitation, without heat, and strain.

ACETUM SANGUINARIÆ. *U.S.* Vinegar of Sanguinaria.

	By measure.
Sanguinaria, in No. 30 powder, 10 parts, or	1¼ oz. av.
Diluted Acetic Acid, a sufficient quantity,	
To make 100 parts, or	1 pint.

Moisten the powder with *five parts* [or 1 fl. oz.] of Diluted Acetic Acid, pack it firmly in a conical glass percolator, and gradually pour Diluted Acetic Acid upon it until *one hundred parts* [or 1 pint] of filtered liquid are obtained.

ACETUM SCILLÆ. *U.S.* Vinegar of Squill.

	By measure.
Squill, in No. 30 powder, 10 parts, or	1¼ oz. av.
Diluted Acetic Acid, a sufficient quantity,	
To make 100 parts, or	1 pint.

Moisten the powder with *thirty parts* [or 5 fl. oz.] of Diluted Acetic Acid, and, after the mixture has ceased to swell, transfer it to a conical glass percolator, pack it carefully, and gradually pour Diluted Acetic Acid upon it until *one hundred parts* [or 1 pint] of filtered liquid are obtained.

CHAPTER XXX.

SOLID PREPARATIONS MADE BY PERCOLATION.

Extracta. *Extracts.*

EXTRACTS are solid or semi-solid preparations produced by evaporating solutions of vegetable principles. The solutions may be made by percolating the drug with water, alcohol, diluted alcohol of various strengths, ether, diluted acetic acid, or diluted solution of ammonia, and the extracts made from such percolates are termed respectively *aqueous*, *alcoholic*, *hydro-alcoholic*, *ethereal*, *acetic*, or *ammoniated* extracts. In addition to this, the juices of fresh plants extracted by contusion and expression are evaporated, and such extracts are frequently called *Succi Spissati*, or *inspissated juices*.

Preparation of Inspissated Juices.—The variation in the amount of extractive matter afforded by expressing fresh plants is so great that the quality of this class of extracts is necessarily very uncertain. Although alcoholic extracts are also subject to variations, experience has shown that they are much more reliable, when properly made, than extracts prepared from expressed juices. For this reason inspissated juices, with one exception, were not recognized in the U.S. Pharmacopœia of 1880. Extract of taraxacum, the sole representative of the class remaining, is at best a feeble preparation, and is fast passing out of use as an active remedy. The inspissated juices most largely consumed in America are made in Great Britain, and the general formula of the British Pharmacopœia is appended:

Bruise the fresh plant in a stone mortar, and press out the juice; heat it gradually to 130° F., and separate the green colouring matter by a calico filter. Heat the strained liquid to 200° F. to coagulate the albumen, and filter again. Evaporate the filtrate by a water-bath to the consistence of a thin syrup; then add to it the green colouring matter previously separated, and, stirring the whole assiduously, continue the evaporation at a temperature not exceeding 140° F., until the extract is of a suitable consistence for forming pills.

Prof. Herrara has proposed a plan of making extracts without the use of much heat,—*by freezing the juices*. He finds that by compressing the frozen juice the expressed liquid, or mother-liquor, is greatly strengthened, the water being largely removed as ice, which remains in the press-cloth, and the concentrated juice is then dried by exposure on plates to the sun.

The percolates, or expressed juices of drugs, contain, in addition to the active principles, certain inert substances, which exist in the liquids in varying quantities. The amount of inert matter found in the extract

depends largely upon the manipulation, but the composition of extracts also varies with the nature of the drug, the character of the solvent, and the mode of preparation. The object is generally to obtain as much of the active principle of the plant, with as little of the inert matter, as possible; though sometimes it may be desirable to separate two active ingredients from each other, when their effects upon the system are materially different: this may be partially accomplished by employing a menstruum which, while it dissolves one, leaves the other untouched. The proximate principles most commonly present in extracts are *gum*, *sugar*, *starch*, *tannin*, *extractive*, *chlorophyl*, *coloring-matter*, *salts*, and the *peculiar principles of plants;* to which, when a spirituous solvent is employed, may usually be added *resinous substances*, *fatty matter*, and frequently more or less *volatile* oil; gum and starch being excluded when the menstruum is pure alcohol.

Extractive.—It has long been known that in most vegetable bodies there is a substance, soluble both in water and in alcohol, which, in the preparation of extracts, undergoes chemical change during the process of evaporation, imparting to the liquid, even if originally limpid, first a greenish, then a yellowish-brown, and ultimately a deep brown color, and becoming itself insoluble. This substance has received the appropriate name of *extractive*, derived from its frequent presence in extracts. Its existence as a distinct principle is denied, or at least doubted, by some chemists, who consider the phenomena supposed to result from its presence as depending upon the mutual reaction of other principles. The most important property of extractive is its disposition to pass, by the influence of atmospheric air at a high temperature, into an insoluble substance. If a vegetable infusion or decoction be evaporated in the open air to the consistence of an extract, then diluted, filtered, and again evaporated, and the process repeated so long as any insoluble matter is formed, the whole of the extractive will be separated from the liquid, while the other ingredients may remain. If chlorine be passed through an infusion or decoction, a similar precipitate is formed with much greater rapidity. The change is usually ascribed to the absorption of oxygen by the extractive, which has, therefore, been called, in its altered condition, oxidized extractive; but De Saussure ascertained that, though oxygen is absorbed during the process, an equal measure of carbonic acid gas is given out, and the oxygen and hydrogen of the extractive unite to form water in such a manner as to leave the principle richer in carbon than it was originally. The name of oxidized extractive is, therefore, obviously incorrect; and Berzelius long ago proposed to substitute for it that of *apotheme*, synonymous with deposit. According to Berzelius, apotheme is not completely insoluble in water, but imparts a slight color to that liquid when cold, and is rather more soluble in boiling water, which becomes turbid upon cooling. It is still more soluble in alcohol, and is freely dissolved by solutions of the alkalies and alkaline carbonates, from which it is precipitated by acids. It has a great tendency, when precipitated from solutions, to unite with other principles and to carry them along with it, thus acquiring properties somewhat different according to the source from which it is obtained. In this way, also, even when the extractive of a plant is itself medicinally

inert, its conversion into apotheme may be injurious by causing a precipitation of a portion of the active principle; and in practical pharmaceutical operations this change should always, if possible, be avoided.

Variable Quality of Extracts.—*It is evident that there must be great variation in the quality of these preparations as found in commerce,* for, whether made by any of the processes commonly employed, or by a special patented process, the lack of a fixed standard to determine the amount of moisture which is to remain in the extracts renders them very variable in strength. The Pharmacopœia is necessarily compelled to avoid specifying an exact limit in this respect, and the approximate standard of "*pilular consistence*" is adopted. The new preparations considered in another place, called *abstracts*, have a great advantage over extracts in this respect. It should be said in addition that the variation in the strength of extracts of pilular consistence does not cease even after their manufacture. The exposure to the air which they are subject to in dispensing, particularly if kept in the customary open queen's-ware jars, causes loss of moisture, and they become hard, and consequently stronger, in proportion to the quantity of moisture that is thus lost: this loss may in some cases amount to as much as twenty-five per cent. In moist climates, however, some extracts absorb moisture and become thinner. The greatest variation in the commercial extracts, however, arises from the difference in the alcoholic strength of the menstruum employed. This may be best illustrated by taking the case of extract of jalap. Alcohol always dissolves the active principles, whilst water is the best solvent for those that are inert. If a manufacturer in making extract of jalap uses equal parts of alcohol and water, he will obtain twice as much extract as the manufacturer who simply uses alcohol; but the alcoholic extract or resin has twice the strength of the hydro-alcoholic extract, and is worth double the price, because it has been shown by actual experiment that the aqueous extract of jalap is absolutely inert even in doses of two hundred and forty grains. The difference between the relative merits of alcoholic and aqueous extracts does not so clearly appear in many of the extracts as in the instance just noted, but it is shown in such important extracts as those from belladonna, hyoscyamus, digitalis, etc., for here the strength depends largely upon the menstrua used in exhausting them, water removing the inert principles, starch, gum, albumen, sugar, salt, etc. The relative value of commercial extracts must depend upon the amount of *active* principles present; and as the manufacturer never states upon the label the menstruum that he has employed in making the extract, nor the yield of the extract from the drug from which it was prepared, and as each manufacturer uses the menstruum that he thinks best, the pharmacist and physician have no means of knowing the dose of the extract, nor can they usually form any correct judgment of its value without a therapeutical experiment or analytical assay. It will be seen, therefore, from the foregoing considerations that extracts are among the most *unreliable* of all classes of preparations. It is greatly to be regretted that manufacturers do not *strictly adhere* to the menstrua directed in the Pharmacopœia, for the sake of securing uniformity, if for no other reason.

Preparation of Extracts.—The manipulations necessary to produce

extracts have all been treated of under the various heads of Maceration, Expression, Percolation, Decoction, Infusion, Evaporation, Use of Steam Heat, Vacuum Apparatus, etc. The special precautions necessary for each extract will be noticed in the officinal working formulas which follow. The details of the formulas vary so much that a general formula is of little value, except to serve as a type for the alcoholic extracts, which resemble one another more closely than any of the others do.

Preservation of Extracts.—The general practice is to take no especial care in the preservation of extracts. This arises from the incorrect impression that they are permanent preparations and do not need it. The manufacturers seal the jars or bottles which contain them, because experience has compelled them to be very careful about this, to avoid loss in transportation,—in the case of soft extracts, through inversion of the jar. The loosely-fitting covers to the jars permit the exposure which causes the variation above noticed, and it is impracticable for the pharmacist on every occasion to seal the jar immediately after he has used a portion of the extract. Several expedients have been suggested to overcome these difficulties. It is a good practice to enclose the jar in a tightly-fitting tin can, or to put the extract in a jar with a screw-cap cover which has a thin cork disk in the top to aid in making a tight joint.

General Formula for Alcoholic Extracts.—Percolate the powdered drug with the menstruum directed, until it is exhausted; reserve the first third of the percolate, evaporate the remainder at a temperature not exceeding 50° C. (122° F.) until it weighs ten per cent. of the weight of the drug. Mix this with the reserved portion, and evaporate both at the above temperature to a pilular consistence. Or, instead of reserving a part of the percolate, the whole quantity is distilled until the alcohol is recovered, and the residue is evaporated to a pilular consistence. In the case of those extracts which are apt to become hard, five per cent. of glycerin is added to enable them to retain their consistence.

Officinal Extracts.—The officinal extracts are *thirty-two* in number. Of these, *nineteen* are made with alcoholic menstrua of various strengths, —viz., Extracts of Aconite, Cannabis Indica, Juglans, Mezereum, Physostigma, Nux Vomica, Cinchona (yellow), Podophyllum, Iris, Rhubarb, Belladonna (leaves), Digitalis, Leptandra, Hyoscyamus, Arnica Root, Colocynth, Conium (fruit), Euonymus, Stramonium (seed).

Nine officinal extracts are made with an aqueous menstruum,—viz., Extracts of Aloes, Gentian, Glycyrrhiza, Hæmatoxylon, Krameria, Malt, Opium, Quassia, Colchicum (root).

One extract is percolated with water containing five per cent. of water of ammonia,—*i.e.*, Pure Extract of Glycyrrhiza.

One extract is made with a menstruum composed of water containing 23.3 per cent. of officinal acetic acid,—*i.e.*, Extract of Colchicum Root.

One extract is made by evaporating a fluid extract,—*i.e.*, Extract of Ergot.

One extract is made by mixing extracts with aromatics, etc.,—*i.e.*, Compound Extract of Colocynth.

One extract is an inspissated juice,—*i.e.*, Extract of Taraxacum.

Table of Officinal Extracts arranged according to the Alcoholic Strength of their Menstrua.

Name and Menstruum.	Fineness of Powder.	Quantity to moisten 100 Parts of Drug.	Quantity reserved.	Percentage of Glycerin added to Extract.	Process and Notes.
Alcohol.					
Extractum Aconiti (Root with 1 p.c. Tartaric Acid).	60	40	90	5	Percolating after 48 hours' maceration, reserving 90 per cent. of percolate, evaporating the remainder to 10 per cent., adding the reserved portion, and evaporating at temperature not above 50° C. (122° F.) to pilular consistence.
Mezerei.	30	40	90		" " " "
Physostigmatis.	40	40	90		" " " "
Cannabis Indicæ.	20	30			Percolating to exhaustion after 48 hours' maceration, distilling off alcohol, evaporating to pilular consistence.
Juglandis.	30	40		5	" " " "
Alcohol 8, Water 1.					
Extractum Nucis Vomicæ.	60	100			" " " "
Alcohol 3, Water 1.					
Extractum Cinchonæ.	60	35		5	Percolating to exhaustion after 48 hours' maceration, using diluted alcohol to finish, and distilling off alcohol, evaporating to pilular consistence.
Iridis.	60	40			" " " "
Podophylli.	60	30			Percolating until five times the weight of powder in percolate is obtained, distilling off alcohol, evaporating to pilular consistence.
Rhei.	30	40	100		Percolating to exhaustion *without* maceration, reserving the first 100 parts of percolate from 100 parts of drug, and spontaneously evaporating this reserved portion to one-half its weight, evaporating the remainder to the consistence of syrup, mixing with reserved portion, evaporating to pilular consistence.
Alcohol 2, Water 1.					
Extractum Belladonnæ Alcoholicum (leaves).	60	40	90	5	Percolating to exhaustion after 48 hours' maceration, using diluted alcohol to finish, reserving 90 per cent. of percolate, evaporating the remainder to 10 per cent., mixing with reserved portion, and evaporating at temperature not above 50° C. (122° F.) to pilular consistence.
Hyoscyami Alcoholicum.	60	40	90		" " " "

Officinal Extracts.—(*Continued.*)

Name and Menstruum.	Fineness of Powder.	Quantity to moisten 100 Parts of Drug.	Quantity reserved.	Percentage of Glycerin added to Extract.	Process and Notes.
Alcohol 2, Water 1.					
Extractum Digitalis.	60	40		5	Percolating to exhaustion after 48 hours' maceration, using diluted alcohol to finish, distilling off alcohol, evaporating to a pilular consistence.
Leptandræ.	40	40		5	" " " "
Diluted Alcohol.					
Extractum Arnicæ Radicis.	60	40	90	5	Percolating to exhaustion after 24 hours' maceration, reserving 90 per cent. of percolate, evaporating the remainder to 10 per cent., mixing with reserved portion, and evaporating at a temperature not above 50° C. (122° F.) to a pilular consistence.
Conii Alcoholicum (fruit).	40	80	90	5	Same process as for Arnica Root, except the time of maceration, which is 48 hours, and with the addition of 3 per cent. of diluted hydrochloric acid to weak percolate to fix the alkaloid.
Euonymi.	30	40		5	Percolating to exhaustion after 48 hours' maceration, distilling off alcohol from percolate, evaporating to a pilular consistence.
Stramonii (seed).	40	80	90		Percolating to exhaustion after 48 hours' maceration, reserving 90 per cent. of percolate, evaporating the remainder to 10 per cent., mixing with reserved portion, and evaporating at a temperature not above 50° C. (122° F.) to a pilular consistence.
Colocynthidis (freed from seeds).	Coarse powder.				Macerating for 4 days, expressing and straining tincture through flannel, percolating residue, distilling the mixed tinctures to recover the alcohol, evaporating residue to dryness: making into a *powdered extract*.
Alcohol 3, Water 4.					
Extractum Ergotæ.					Made by evaporating Fluid Extract of Ergot (which is made with a menstruum consisting of 3 parts of alcohol and 4 parts of water) to a pilular consistence.
Water.					
Extractum Aloes Aquosum.					Maceration. *Macerating* in boiling water, with stirring, letting the mixture stand for 12 hours, decanting the liquid, evaporating to dryness: making into a *powdered extract*.
Hæmatoxyli.					Maceration. *Macerating* with cold water for 48 hours, boiling, straining the decoction while hot, evaporating to dryness: making into a *powdered extract*.

Officinal Extracts.—(*Continued.*)

Name and Menstruum.	Fineness of Powder.	Quantity to moisten 100 Parts of Drug.	Quantity reserved.	Percentage of Glycerin added to Extract.	Process and Notes.
Water.					
Extractum Opii.				5	Maceration. *Macerating* repeatedly in cold water, expressing, evaporating the mixed liquids to a pilular consistence.
Malti.	12				*Macerating* and digesting with warm and hot water, expressing, evaporating strained liquid at a temperature not above 55° C. (131° F.) to *consistence of thick honey.*
Taraxaci.					Inspissated juice from the fresh plant.
Gentianæ.	20	40			Percolating to exhaustion after 24 hours' maceration, boiling the percolate until reduced to three-fourths of its weight, straining, evaporating to a pilular consistence.
Glycyrrhizæ Purum.	20	100			Percolating to exhaustion after 24 hours' maceration with water, containing 5 *per cent. of Water of Ammonia* to dissolve the Glycyrrhizin, evaporating to a pilular consistence.
Krameriæ.	40	30			Percolating to exhaustion, heating the liquid to the boiling-point, straining, evaporating at a temperature not above 70° C. (158° F.) to dryness.
Quassiæ.	20	40		5	Percolating to exhaustion, reducing the liquid to three-fourths of its weight by boiling, straining, evaporating to a pilular consistence.
Colchici Radicis.	60	50			Percolating to exhaustion after macerating with water containing 23.3 *per cent. of Officinal Acetic Acid*, evaporating the percolate at a temperature not above 80° C. (176° F.) to a pilular consistence.
Glycyrrhizæ.					*Commercial extract* in rolls: not less than 60 per cent. of it should be soluble in cold water.
	Compound Extract.				
Colocynthidis Compositum.	Extract of Colocynth, 16 p.c. Aloes, 50 p.c. Cardamom, No. 60 powder, 6 p.c. Resin of Scammony, 14 p.c. Soap, dried, and in coarse powder, 14 p.c. Alcohol, 10 p.c. of the combined weight of the other ingredients.				Melting the Aloes by heating, adding the Alcohol, straining the mixture, adding the Soap, Extract of Colocynth, and Resin of Scammony, heating the mixture until homogeneous, withdrawing the heat, and adding the Cardamom; when cold, *reducing the product to a fine powder.*

EXTRACTUM ACONITI. *U.S.* Extract of Aconite.

	By measure.
Aconite, in No. 60 powder, 100 parts, or	16 oz. av.
Tartaric Acid, 1 part, or	70 grains.
Glycerin,	
Alcohol, each, a sufficient quantity.	

Moisten the powder with *forty parts* [or 7½ fl. oz.] of Alcohol in which the Tartaric Acid has previously been dissolved, and pack it firmly in a cylindrical glass percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until *three hundred parts* [or 3½ pints] of tincture are obtained, or the Aconite is exhausted. Reserve the first *ninety parts* [or 15½ fl. oz.] of the percolate, evaporate the remainder in a porcelain capsule at a temperature not exceeding 50° C. (122° F.), to *ten parts* [or 1½ fl. oz.], add the reserved portion, and evaporate at or below the above-mentioned temperature, until an extract of a pilular consistence remains. Lastly, weigh the Extract, and thoroughly incorporate with it, while still warm, *five per cent.* of Glycerin.

EXTRACTUM ALOES AQUOSUM. *U.S.* Aqueous Extract of Aloes.

	By measure.
Aloes, 100 parts, or	16 oz. av.
Boiling Distilled Water, 1000 parts, or	10 pints.

Mix the Aloes with the Water in a suitable vessel, stirring constantly, until the particles of Aloes are thoroughly disintegrated, and let the mixture stand for twelve hours; then pour off the clear liquor, strain the residue, mix the liquids, and evaporate to dryness by means of a water- or steam-bath.

EXTRACTUM ARNICÆ RADICIS. *U.S.* Extract of Arnica Root.

	By measure.
Arnica Root, in No. 60 powder, 100 parts, or	16 oz. av.
Glycerin,	
Diluted Alcohol, each, a sufficient quantity.	

Moisten the powder with *forty parts* [or 6½ fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until *three hundred parts* [or 3 pints] of tincture are obtained, or the Arnica Root is exhausted. Reserve the first *ninety parts* [or 14 fl. oz.] of the percolate; evaporate the remainder to *ten parts* [or 2 fl. oz.], at a temperature not exceeding 50° C. (122° F.), mix the residue with the reserved portion, and evaporate, at or below the above-mentioned temperature, to a pilular consistence. Lastly, weigh the Extract, and thoroughly incorporate with it, while still warm, *five per cent.* of Glycerin.

EXTRACTUM BELLADONNÆ ALCOHOLICUM. *U.S.* Alcoholic Extract of Belladonna.

	By measure.
Belladonna Leaves, in No. 60 powder, 100 parts, or	16 oz. av.
Alcohol, 200 parts, or	2 pints and 4 fl. oz.
Water, 100 parts, or	1 pint.
Glycerin,	
Diluted Alcohol, each, a sufficient quantity.	

Mix the Alcohol and Water, and, having moistened the powder with *forty parts* [or 7 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then Diluted Alcohol, until *three hundred parts* [or 3 pints] of tincture are obtained, or the Belladonna Leaves are exhausted. Reserve the first *ninety parts* [or 14 fl. oz.] of the percolate, evaporate the remainder at a temperature not exceeding 50° C. (122° F.), to *ten parts* [or 2 fl. oz.], mix the residue with the reserved portion, and evaporate at or below the above-mentioned temperature to a pilular consistence. Lastly, weigh the Extract, and thoroughly incorporate with it, while still warm, *five per cent.* of Glycerin.

EXTRACTUM CANNABIS INDICÆ. *U.S.* Extract of Indian Cannabis.

	By measure.
Indian Cannabis, in No. 20 powder, 100 parts, or	16 oz. av.
Alcohol, a sufficient quantity.	

Moisten the powder with *thirty parts* [or 7 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol until *three hundred parts* [or 3½ pints] of Tincture are obtained, or the Cannabis is exhausted. By means of a water-bath, distil off the Alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence.

EXTRACTUM CINCHONÆ *U.S.* Extract of Cinchona.

	By measure.
Yellow Cinchona, in No. 60 powder, 100 parts, or	16 oz. av.
Alcohol, 300 parts, or	3½ pints.
Water, 100 parts, or	1 pint.
Glycerin,	
Diluted Alcohol, each, a sufficient quantity.	

Mix the Alcohol and Water, and, having moistened the powder with *thirty-five parts* [or 6 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation

to proceed, gradually adding, first, the remainder of the menstruum, and then Diluted Alcohol, until *four hundred parts* [or 4½ pints] of tincture are obtained, or the Cinchona is exhausted. By means of a water-bath, distil off the Alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it on a water-bath, to a pilular consistence. Lastly, weigh the Extract, and thoroughly incorporate with it, while still warm, *five per cent.* of Glycerin.

EXTRACTUM COLCHICI RADICIS. *U.S.* **Extract of Colchicum Root.**

	By measure.
Colchicum Root, in No. 60 powder, 100 parts, or	16 oz. av.
Acetic Acid, 35 parts, or	5½ fl. oz.
Water, a sufficient quantity.	

Mix the Acetic Acid with *one hundred and fifty parts* [or 23 fl. oz.] of Water, and, having moistened the powder with *fifty parts* [or 7½ fl. oz.] of the mixture, pack it moderately in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then Water, until the Colchicum Root is exhausted. Evaporate the percolate, in a porcelain vessel, by means of a water-bath, at a temperature not exceeding 80° C. (176° F.), to a pilular consistence.

EXTRACTUM COLOCYNTHIDIS. *U.S.* **Extract of Colocynth.**

	By measure.
Colocynth, dried, and freed from the seeds, 100 parts, or	16 oz. av.
Diluted Alcohol, a sufficient quantity.	

Reduce the Colocynth to a coarse powder by grinding or bruising, and macerate it in *two hundred and fifty parts* [or 41 fl. oz.] of Diluted Alcohol for four days, with occasional stirring; then express strongly, and strain through flannel. Pack the residue, previously broken up with the hands, firmly in a cylindrical percolator, cover it with the strainer, and gradually pour Diluted Alcohol upon it until the tincture and expressed liquid, mixed together, weigh *five hundred parts* [or measure 5 pints]. Having recovered from the mixture *three hundred parts* [or 3½ pints] of Alcohol by distillation, evaporate the residue to dryness, by means of a water-bath. Lastly, reduce the dry mass to powder.

Extract of Colocynth should be kept in well-stopped bottles.

EXTRACTUM COLOCYNTHIDIS COMPOSITUM. *U.S.* **Compound Extract of Colocynth.**

	By measure.
Extract of Colocynth, 16 parts, or	8 oz. av.
Aloes, 50 parts, or	25 oz. av.
Cardamom, in No. 60 powder, 6 parts, or	3 oz. av.
Resin of Scammony, in fine powder, 14 parts, or	7 oz. av.
Soap, dried and in coarse powder, 14 parts, or	7 oz. av.
Alcohol, 10 parts, or	6 fl. oz.

Heat the Aloes, on a water-bath, until it is completely melted; then add the Alcohol, and, having stirred the mixture thoroughly, strain it

through a fine sieve, which has just been dipped into boiling water. To the strained mixture, contained in a suitable vessel, add the Soap, Extract of Colocynth, and Resin of Scammony, and heat the mixture at a temperature not exceeding 120° C. (248° F.), until it is perfectly homogeneous, and a thread taken from the mass becomes brittle when cool. Then withdraw the heat, thoroughly incorporate the Cardamom with the mixture, and cover the vessel until the contents are cold. Finally, reduce the product to a fine powder.

Compound Extract of Colocynth should be kept in well-stopped bottles.

EXTRACTUM CONII ALCOHOLICUM. *U. S.* **Alcoholic Extract of Conium.**

	By measure.
Conium, in No. 40 powder, 100 parts, or	16 oz. av.
Diluted Hydrochloric Acid, 3 parts, or	3 fl. dr.
Glycerin,	
Diluted Alcohol, each, a sufficient quantity.	

Moisten the powder with *thirty parts* [or 4½ fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until *three hundred parts* [or 3 pints] of tincture are obtained, or until the Conium is exhausted. Reserve the first *ninety parts* [or 14 fl. oz.] of the percolate, add the Diluted Hydrochloric Acid to the remainder, and evaporate it, at a temperature not exceeding 50° C. (122° F.), to *ten parts* [or 1½ fl. oz.]; mix this with the reserved portion, in a porcelain capsule, and evaporate at or below the before-mentioned temperature, to a pilular consistence. Lastly, weigh the Extract, and thoroughly incorporate with it, while still warm, *five per cent.* of Glycerin.

EXTRACTUM DIGITALIS. *U. S.* **Extract of Digitalis.**

	By measure.
Digitalis, recently dried and in No 60 powder, 100 parts, or	16 oz. av.
Alcohol, 200 parts, or	2¼ pints.
Water, 100 parts, or	1 pint.
Glycerin,	
Diluted Alcohol, each, a sufficient quantity.	

Mix the Alcohol and Water, and, having moistened the powder with *forty parts* [or 6 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then, Diluted Alcohol, until *three hundred parts* [or 3 pints] of tincture are obtained, or the Digitalis is exhausted. By means of a water-bath, distil off the Alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence. Lastly, weigh the Extract, and thoroughly incorporate with it, while still warm, *five per cent.* of Glycerin.

EXTRACTUM ERGOTÆ. *U.S.* Extract of Ergot.

Fluid Extract of Ergot, 500 parts, or	16 oz. av.
To make 100 parts, or	3 oz. 88 gr. av.

Evaporate the Fluid Extract of Ergot in a porcelain capsule, by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), constantly stirring, until it is reduced to *one hundred parts* [or 3 oz. 88 grains av.].

EXTRACTUM EUONYMI. *U.S.* Extract of Euonymus.

	By measure.
Euonymus, in No. 30 powder, 100 parts, or	16 oz. av.
Glycerin,	
Diluted Alcohol, each, a sufficient quantity.	

Moisten the powder with *forty parts* [or 6 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until *three hundred parts* [or 3 pints] of tincture are obtained, or the Euonymus is exhausted. By means of a water-bath, distil off the Alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence. Lastly, weigh the Extract, and thoroughly incorporate with it, while still warm, *five per cent.* of Glycerin.

EXTRACTUM GENTIANÆ. *U.S.* Extract of Gentian.

	By measure.
Gentian, in No. 20 powder, 100 parts, or	16 oz. av.
Water, a sufficient quantity.	

Moisten the powder with *forty parts* [or 6 fl. oz.] of Water, and let it macerate for twenty-four hours; then pack it in a conical percolator, and gradually pour Water upon it until the infusion passes but slightly imbued with the properties of the Gentian. Reduce the liquid to three-fourths of its weight by boiling, and strain; then, by means of a water-bath, evaporate to a pilular consistence.

EXTRACTUM GLYCYRRHIZÆ. *U.S.* Extract of Glycyrrhiza.

[EXTRACT OF LIQUORICE.]

The commercial extract of the root of *Glycyrrhiza glabra* Linné (Nat. Ord., *Leguminosæ*, *Papilionaceæ*).

In flattened, cylindrical rolls, from six inches to six and three-quarter inches (150 to 175 millimeters) long, and from five-eighths to one and one-sixteenth inches (15 to 30 millimeters) thick; of a glossy black color. It breaks with a sharp, conchoidal, shining fracture, and has a very sweet, peculiar taste. Not less than 60 per cent. of it should be soluble in cold water.

EXTRACTUM GLYCYRRHIZÆ PURUM. *U. S.* **Pure Extract of Glycyrrhiza.**

	By measure.
Glycyrrhiza, in No. 20 powder, 100 parts, or	16 oz. av.
Water of Ammonia, 15 parts, or	2½ fl. oz.
Distilled Water, a sufficient quantity.	

Mix the Water of Ammonia with *three hundred parts* [or 3 pints] of Distilled Water, and, having moistened the powder with *one hundred parts* [or 1 pint] of the menstruum, let it macerate for twenty-four hours. Then pack it moderately in a cylindrical glass percolator, and gradually pour upon it, first, the remainder of the menstruum, and then, Distilled Water, until the Glycyrrhiza is exhausted. Lastly, by means of a water-bath, evaporate the infusion to a pilular consistence.

EXTRACTUM HÆMATOXYLI. *U. S.* **Extract of Hæmatoxylon.**

	By measure.
Hæmatoxylon, rasped, 100 parts, or	16 oz. av.
Water, 1000 parts, or	10 pints.

Macerate the Hæmatoxylon with the Water for forty-eight hours. Then boil (avoiding the use of metallic vessels) until one-half of the Water has evaporated; strain the decoction, while hot, and evaporate to dryness.

EXTRACTUM HYOSCYAMI ALCOHOLICUM. *U. S.* **Alcoholic Extract of Hyoscyamus.**

	By measure.
Hyoscyamus, recently dried and in No. 60 powder, 100 parts, or	16 oz. av.
Alcohol, 200 parts, or	2¼ pints.
Water, 100 parts, or	1 pint.
Diluted Alcohol, a sufficient quantity.	

Mix the Alcohol and Water, and, having moistened the powder with *forty parts* [or 6 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then, Diluted Alcohol, until *three hundred parts* [or 3 pints] of tincture are obtained, or the Hyoscyamus is exhausted. Reserve the first *ninety parts* [or 14 fl. oz.] of the percolate, evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to *ten parts* [or 1 fl. oz.]; mix this with the reserved portion, and evaporate, at or below the before-mentioned temperature, to a pilular consistence.

EXTRACTUM IRIDIS. *U. S.* **Extract of Iris.**

	By measure.
Iris, in No. 60 powder, 100 parts, or	16 oz. av.
Alcohol, 225 parts, or	2½ pints.
Water, 75 parts, or	12 fl. oz.
Diluted Alcohol, a sufficient quantity.	

Mix the Alcohol and Water, and, having moistened the powder with

forty parts [or 6½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then, Diluted Alcohol, until *three hundred parts* [or 3 pints] of tincture are obtained, or the Iris is exhausted. By means of a water-bath, distil off the Alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence.

EXTRACTUM JUGLANDIS. *U.S.* Extract of Juglans.

	By measure.
Juglans, in No. 80 powder, 100 parts, or	16 oz. av.
Glycerin,	
Alcohol, each, a sufficient quantity.	

Moisten the powder with *forty parts* [or 6 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until *three hundred parts* [or 3 pints] of tincture are obtained, or the Juglans is exhausted. By means of a water-bath, distil off the Alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence. Lastly, weigh the Extract, and thoroughly incorporate with it, while still warm, *five per cent.* of Glycerin.

EXTRACTUM KRAMERIÆ. *U.S.* Extract of Krameria.

	By measure.
Krameria, in No. 40 powder, 100 parts, or	16 oz. av.
Water, a sufficient quantity.	

Moisten the powder with *thirty parts* [or 4½ fl. oz.] of Water, pack it in a conical glass percolator, and gradually pour Water upon it, until the infusion passes but slightly imbued with the astringency of the Krameria. Heat the liquid to the boiling point, strain, and, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), evaporate to dryness.

EXTRACTUM LEPTANDRÆ. *U.S.* Extract of Leptandra.

	By measure.
Leptandra, in No. 40 powder, 100 parts, or	16 oz. av.
Alcohol, 200 parts, or	2¼ pints.
Water, 100 parts, or	1 pint.
Glycerin,	
Diluted Alcohol, each, a sufficient quantity.	

Mix the Alcohol and Water, and, having moistened the powder with *forty parts* [or 6 fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely cov-

ered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then, Diluted Alcohol, until *three hundred parts* [or 3 pints] of tincture are obtained or the Leptandra is exhausted. By means of a water-bath, distil off the Alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence. Lastly, weigh the Extract, and thoroughly incorporate with it, while still warm, *five per cent.* of Glycerin.

EXTRACTUM MALTI. *U.S.* Extract of Malt.

	By measure.
Malt, in coarse powder, not finer than No. 12, 100 parts, or	80 oz. av.
Water, a sufficient quantity.	

Upon the powder, contained in a suitable vessel, pour *one hundred parts* [or 5 pints] of Water, and macerate for six hours. Then add *four hundred parts* [or 20 pints] of Water, heated to about 30° C. (86° F.), and digest for an hour at a temperature not exceeding 55° C. (131° F.). Strain the mixture with strong expression. Finally, by means of a water-bath, or vacuum-apparatus, at a temperature not exceeding 55° C. (131° F.), evaporate the strained liquid rapidly to the consistence of thick honey.

Keep the product in well-closed vessels, in a cool place.

EXTRACTUM MEZEREI. *U.S.* Extract of Mezereum.

	By measure.
Mezereum, in No. 80 powder, 100 parts, or	16 oz. av.
Alcohol, a sufficient quantity.	

Moisten the powder with *forty parts* [or 6 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until *three hundred parts* [or 3 pints] of tincture are obtained, or the Mezereum is exhausted. Reserve the first *ninety parts* [or 13 fl. oz.] of the percolate; evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to *ten parts* [or 2 fl. oz.]; mix this with the reserved portion, and evaporate, at or below the before-mentioned temperature, in a porcelain capsule, on a water-bath, to a pilular consistence.

EXTRACTUM NUCIS VOMICÆ. *U.S.* Extract of Nux Vomica.

	By measure.
Nux Vomica, in No. 60 powder, 100 parts, or	16 oz. av.
Alcohol,	
Water, each, a sufficient quantity.	

Mix Alcohol and Water in the proportion of *eight parts* [or 4½ pints] of Alcohol and *one part* [or ½ pint] of Water, and, having moistened the powder with *one hundred parts* [or 15 fl. oz.] of the mixture, let it macerate in a closed vessel, in a warm place, for forty-eight hours. Then pack it in a cylindrical percolator, and gradually pour menstruum upon it, until the tincture passes but slightly imbued with bitterness. By means of a water-bath, distil off the Alcohol from the tincture,

and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence.

EXTRACTUM OPII. *U.S.* Extract of Opium.

	By measure.
Opium, 100 parts, or	16 oz. av.
Water, 750 parts, or	7½ pints.
Glycerin, a sufficient quantity.	

Cut the Opium into small pieces, let it macerate for twenty-four hours in *one hundred and fifty parts* [or 1½ pints] of the Water, and reduce it to a soft mass by trituration. Express the liquid from it, and treat the residue again in the same manner with *one hundred and fifty parts* [or 1½ pints] of the Water. Repeat the maceration and expression three times more, using a fresh portion of the Water each time. Having mixed the liquids, filter the mixture, and evaporate, by means of a water-bath, to a pilular consistence. Lastly, weigh the Extract, and thoroughly incorporate with it, while still warm, *five per cent.* of Glycerin.

EXTRACTUM PHYSOSTIGMATIS. *U.S.* Extract of Physostigma.

	By measure.
Physostigma, in No. 40 powder, 100 parts, or	16 oz. av.
Alcohol, a sufficient quantity.	

Moisten the powder with *forty parts* [or 6 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until *three hundred parts* [or 3 pints] of tincture are obtained, or the Physostigma is exhausted. Reserve the first *ninety parts* [or 14 fl. oz.] of the percolate; evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to *ten parts* [or 2 fl. oz.], mix this with the reserved portion, and evaporate, at or below the before-mentioned temperature, in a porcelain capsule, on a water-bath, to a pilular consistence.

EXTRACTUM PODOPHYLLI. *U.S.* Extract of Podophyllum.

	By measure.
Podophyllum, in No. 60 powder, 100 parts, or	16 oz. av.
Alcohol,	
Water, each, a sufficient quantity.	

Mix Alcohol and Water in the proportion of *three parts* [or 3¼ pints] of Alcohol and *one part* [or 1 pint] of Water, and, having moistened the powder with *thirty parts* [or 4½ fl. oz.] of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until *five hundred parts* [or 5 pints] of tincture have passed. By means of a water-bath, distil off the Alcohol from the tincture, and evaporate the residue to a pilular consistence.

EXTRACTUM QUASSIÆ. *U.S.* Extract of Quassia.

	By measure.
Quassia, in No. 20 powder, 100 parts, or	16 oz. av.
Glycerin,	
Water, each, a sufficient quantity.	

Moisten the powder with *forty parts* [or 6 fl. oz.] of Water, pack it firmly in a conical percolator, and gradually pour Water upon it until the infusion passes but slightly imbued with bitterness. Reduce the liquid to three-fourths of its weight, by boiling, and strain; then, by means of a water-bath, evaporate to a pilular consistence. Lastly, weigh the Extract, and thoroughly incorporate with it, while still warm, *five per cent.* of Glycerin.

EXTRACTUM RHEI. *U.S.* Extract of Rhubarb.

	By measure.
Rhubarb, in No. 30 powder, 100 parts, or	16 oz. av.
Alcohol,	
Water, each, a sufficient quantity.	

Mix Alcohol and Water in the proportion of *three parts* [or 3½ pints] of Alcohol and *one part* [or 1 pint] of Water, and, having moistened the powder with *forty parts* [or ½ pint] of the mixture, pack it firmly in a conical percolator; then gradually pour the menstruum upon it until the tincture passes nearly tasteless. Reserve the first *one hundred parts* [or 15 fl. oz.] of the percolate, and set it aside in a warm place, until it is reduced by spontaneous evaporation to *fifty parts* [or 8 oz. av.]. Evaporate the remainder of the percolate, in a porcelain vessel, by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), to the consistence of syrup; mix this with the reserved portion, and continue the evaporation until the mixture is reduced to a pilular consistence.

EXTRACTUM STRAMONII. *U.S.* Extract of Stramonium.

	By measure.
Stramonium Seed, in No. 40 powder, 100 parts, or	16 oz. av.
Diluted Alcohol, a sufficient quantity.	

Moisten the powder with *thirty parts* [or 5 fl. oz.] of Diluted Alcohol, and pack it firmly in a cylindrical percolator; then add enough Diluted Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Diluted Alcohol, until *three hundred parts* [or 3 pints] of tincture are obtained, or the Stramonium Seed is exhausted. Reserve the first *ninety parts* [or 14 fl. oz.] of the percolate, evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to *ten parts* [or 2 fl. oz.], mix the residue with the reserved portion in a porcelain capsule, and, by means of a water-bath, evaporate, at or below the before-mentioned temperature, to a pilular consistence.

EXTRACTUM TARAXACI. *U.S.* Extract of Taraxacum.

Fresh Taraxacum, gathered in September, a convenient quantity,
Water, a sufficient quantity.

Slice the Taraxacum, and bruise it in a stone mortar, sprinkling on it a little Water, until reduced to a pulp; then express and strain the juice, and evaporate it in a vacuum-apparatus, or in a shallow porcelain dish, by means of a water-bath, to a pilular consistence.

Abstracta. *Abstracts.*

Abstracts are solid powdered preparations containing the soluble constituents of the drugs from which they are made, and bearing a definite and uniform relation to the drug. These preparations were first introduced into the U. S. Pharmacopœia of 1880, and have many advantages over ordinary extracts. They are prepared by evaporating an alcoholic tincture of a drug spontaneously and at a low temperature, mixing it with a sufficient quantity of dried sugar of milk to make the final product when dry weigh one-half the weight of the drug, and then powdering it. The following general formula exhibits the typical officinal process.

General Formula.

Drug, in No. 60 powder, *two hundred parts* [or four ounces av.]; Sugar of Milk, recently dried and in fine powder, Alcohol, each, *a sufficient quantity*, To make *one hundred parts* [or two ounces av.]. Moisten the drug with *eighty parts* [or one and three-quarter fluidounces] of Alcohol, and pack firmly in a cylindrical glass percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the drug is exhausted. Reserve the first *one hundred and seventy parts* [or three and one-half fluidounces] of the percolate, evaporate the remainder to *thirty parts* [or half a fluidounce] at a temperature not exceeding 50° C. (122° F.) and mix with the reserved portion. Place the mixture in an evaporating dish, and, having added *fifty parts* [or one ounce av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or two ounces av.], reduce it to a fine, uniform powder. Preserve the powder in a well-stopped bottle.

The advantages possessed by abstracts may be briefly stated as follows:

1. Each abstract represents twice the strength of the drug or fluid extract from which it is prepared.

2. They are dry powders, if properly made, and thus are permanent and portable; not subject to precipitation as fluid extracts are; not liable to become hard, brittle, and variable in strength, as is the case with extracts.

3. Injurious exposure to heat is entirely avoided, and the officinal process requires no apparatus but such as either is at hand in the pharmacy or can be easily obtained by a pharmacist operating upon the small scale.

4. The final thorough trituration of the dry powder reduces the soluble and active constituents of the drug to a pulverulent condition, the diluent is soluble, and the fine state of division of abstracts is the most favorable condition that a powder can possess to secure efficient medication.

The improvement suggested for the officinal processes for abstracts is, that the temperature 50° C. (122° F.), which is lower than need be, for abstracts of aconite, belladonna, digitalis, hyoscyamus, ignatia, jalap, nux vomica, podophyllum, and senega, be increased to 80° C. (176° F.).

Conium and valerian require a very low temperature, but the temperature of 80° C. (176° F.) is not injurious to those first mentioned if the evaporation of the fluid extract is quickly and carefully effected. An alcoholic fluid extract may be used to prepare an abstract from, if the menstruum used in making it was not too aqueous, and if it is free from glycerin. Dr. Squibb's modification for making abstracts from fluid extracts, as shown in the case of fluid extract of aconite, is as follows: "Put the fluid extract (a weighed quantity) upon a flat-bottomed dinner-plate and allow it to evaporate spontaneously, without heating, for twenty-four or thirty-six hours. At the end of that time there will remain upon the plate a thin layer of solid extract. Add to this extract about double its weight of powdered sugar of milk, warm the plate and contents until it can be just comfortably held in the hand, and incorporate the melted extract and powder by means of a stiff spatula. When thoroughly incorporated and cold, remove the mixture from the plate, weigh it, and add enough powdered sugar of milk to make the whole weigh one-half the original weight of the fluid extract. Finally, rub it to a fine, uniform powder, sifting it through a No. 60 sieve." Abstracts are *not* well made when the dry powdered solid extract is simply rubbed up with dry powdered sugar of milk, as suggested by some writers, because such mixtures of dry powders invariably *stratify* in time. This fault may be easily discovered on close examination, a darker layer of powdered extract being succeeded by a lighter one containing variable proportions of sugar of milk: this arrangement of the particles is largely owing to the vibration to which the bottles containing them are continually subjected on the shelves of the dispensing counter and by use elsewhere. If the officinal process is employed, this fault does not exist, because the particles of sugar of milk become thoroughly saturated with the concentrated liquid extract when mixed together, and when the alcohol evaporates the solid extract is thoroughly diffused among, and is closely adherent to, the particles of sugar of milk: hence a dose taken from the portion at the top or at the middle of the bottle would have the same medicinal effect as one taken from the portion at the bottom.

Preservation and Administration.—Abstracts should be carefully protected from exposure to moist air. They should be kept in small bottles with mouths wide enough to admit the end of a spatula. Corks of the best quality should be used, and the bottles should not be kept near a hot flue, but in as cool a place as possible.

The following table exhibits the *eleven* officinal abstracts in a form convenient for study:

Abstracta. *Abstracts.*

Name.	Fineness of Powder.	Menstruum.	To moisten 200 Parts.	Quantity reserved.	Notes and Additions.
Abstractum Aconiti.	60	Alcohol.	80	170	2 per cent. Tartaric Acid added to menstruum to exhaust Aconite Root.
Belladonnæ.	60	"	80	170	From Belladonna Root.
Conii.	40	"	80	170	6 per cent. Hydrochloric Acid added to menstruum to exhaust Conium Fruit.
Digitalis.	60	"	80	170	
Hyoscyami.	60	"	80	170	
Jalapæ.	40	"	100	170	
Podophylli.	60	"	80	170	
Senegæ.	60	"	80	170	
Valerianæ.	60	"	80	170	
Ignatiæ.	60	Alcohol, 8 / Water, 1	100	170	
Nucis Vomicæ.	60	Alcohol, 8 / Water, 1	100	170	

ABSTRACTUM ACONITI. *U.S.* Abstract of Aconite.

	By measure.
Aconite, in No. 60 powder, 200 parts, or	4 oz. av.
Tartaric Acid, 2 parts, or	18 grains.
Sugar of Milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity,	
To make 100 parts, or	2 oz. av.

Moisten the Aconite with *eighty parts* [or 1¼ fl. oz.] of Alcohol, in which the Tartaric Acid has previously been dissolved, and pack firmly in a cylindrical glass percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Aconite is exhausted. Reserve the first *one hundred and seventy parts* [or 3½ fl. oz.] of the percolate, evaporate the remainder to *thirty parts* [or ½ fl. oz.], at a temperature not exceeding 50° C. (122° F.), and mix with the reserved portion. Place the mixture in an evaporating dish, and, having added *fifty parts* [or 1 oz. av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or 2 oz. av.], reduce it to a fine, uniform powder.

Preserve the powder in a well-stopped bottle.

ABSTRACTUM BELLADONNÆ. *U.S.* Abstract of Belladonna.

	By measure.
Belladonna Root, in No. 60 powder, 200 parts, or	4 oz. av.
Sugar of Milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity,	
To make 100 parts, or	2 oz. av.

Moisten the Belladonna Root with *eighty parts* [or 1¼ fl. oz.] of Alcohol, and pack firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Belladonna Root is exhausted. Reserve the first *one hundred and seventy parts* [or 3½ fl. oz.] of the percolate, evaporate the remainder to *thirty parts* [or ½ fl. oz.], at a temperature not exceeding 50° C. (122° F.), and mix with the reserved portion. Place the mixture in an evaporating dish, and, having added *fifty parts* [or 1 oz. av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or 2 oz. av.], reduce it to a fine, uniform powder.

Preserve the powder in a well-stopped bottle.

ABSTRACTUM CONII. *U.S.* Abstract of Conium.

	By measure.
Conium, in No. 40 powder, 200 parts, or	4 oz. av.
Diluted Hydrochloric Acid, 6 parts, or	50 minims.
Sugar of Milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity,	
To make 100 parts, or	2 oz. av.

Mix the Hydrochloric Acid with *eighty parts* [or 1¼ fl. oz.] of Alcohol, and, having moistened the Conium with the mixture, pack firmly in a cylindrical glass percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Conium is exhausted. Reserve the first *one hundred and seventy parts* [or 3½ fl. oz.] of the percolate, evaporate the remainder to *thirty parts* [or ½ fl. oz.], at a temperature not exceeding 50° C. (122° F.), and mix with the reserved portion. Place the mixture in an evaporating dish, and, having added *fifty parts* [or 1 oz. av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or 2 oz. av.], reduce it to a fine, uniform powder.

Preserve the powder in a well-stopped bottle.

ABSTRACTUM DIGITALIS. *U.S.* Abstract of Digitalis.

	By measure.
Digitalis, recently dried and in No. 60 powder, 200 parts, or	4 oz. av.
Sugar of Milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity,	
To make 100 parts, or	2 oz. av.

Moisten the Digitalis with *eighty parts* [or 1¼ fl. oz.] of Alcohol, and pack firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having

closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Digitalis is exhausted. Reserve the first *one hundred and seventy parts* [or 3½ fl. oz.] of the percolate, evaporate the remainder to *thirty parts* [or ½ fl. oz.], at a temperature not exceeding 50° C. (122° F.), and mix with the reserved portion. Place the mixture in an evaporating dish, and, having added *fifty parts* [or 1 oz. av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or 2 oz. av.], reduce it to a fine, uniform powder.

Preserve the powder in a well-stopped bottle.

ABSTRACTUM HYOSCYAMI. *U.S.* **Abstract of Hyoscyamus.**

	By measure.
Hyoscyamus, recently dried and in No. 60 powder, 200 parts, or	4 oz. av.
Sugar of Milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity,	
To make 100 parts, or	2 oz. av.

Moisten the Hyoscyamus with *eighty parts* [or 1¼ fl. oz.] of Alcohol, and pack firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Hyoscyamus is exhausted. Reserve the first *one hundred and seventy parts* [or 3½ fl. oz.] of the percolate, evaporate the remainder to *thirty parts* [or ½ fl. oz.], at a temperature not exceeding 50° C. (122° F.), and mix with the reserved portion. Place the mixture in an evaporating dish, and, having added *fifty parts* [or 1 oz. av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or 2 oz. av.], reduce it to a fine, uniform powder.

Preserve the powder in a well-stopped bottle.

ABSTRACTUM IGNATIÆ. *U.S.* **Abstract of Ignatia.**

	By measure.
Ignatia, in No. 60 powder, 200 parts, or	4 oz. av.
Sugar of Milk, recently dried and in fine powder,	
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 parts, or	2 oz. av.

Mix the Alcohol and Water in the proportion of *eight parts* [or 6 fl. oz.] of Alcohol to *one part* [or 5 fl. dr.] of Water, and, having moistened the Ignatia with *one hundred parts* [or 2 fl. oz.] of the menstruum, pack firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding men-

struum, until the Ignatia is exhausted. Reserve the first *one hundred and seventy parts* [or 3½ fl. oz.] of the percolate, distil off the Alcohol from the remainder, and mix the residue with the reserved portion. Place the mixture in an evaporating dish, and, having added *fifty parts* [or 1 oz. av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or 2 oz. av.], reduce it to a fine, uniform powder.

Preserve the powder in a well-stopped bottle.

ABSTRACTUM JALAPÆ. *U. S.* Abstract of Jalap.

	By measure.
Jalap, in No. 40 powder, 200 parts, or	4 oz. av.
Sugar of Milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity,	
To make 100 parts, or	2 oz. av.

Moisten the Jalap with *one hundred parts* [or 2 fl. oz.] of Alcohol, and pack firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Jalap is exhausted. Reserve the first *one hundred and seventy parts* [or 3½ fl. oz.] of the percolate, distil off the Alcohol from the remainder, and mix the residue with the reserved portion. Place the mixture in an evaporating dish, and, having added *fifty parts* [or 1 oz. av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or 2 oz. av.], reduce it to a fine, uniform powder.

Preserve the powder in a well-stopped bottle.

ABSTRACTUM NUCIS VOMICÆ. *U. S.* Abstract of Nux Vomica.

	By measure.
Nux Vomica, in No. 60 powder, 200 parts, or	4 oz. av.
Sugar of Milk, recently dried and in fine powder,	
Alcohol,	
Water, each, a sufficient quantity,	
To make 100 parts, or	2 oz. av.

Mix Alcohol and Water in the proportion of *eight parts* [or 6 fl. oz.] of Alcohol to *one part* [or 5 fl. dr.] of Water, and, having moistened the Nux Vomica with *one hundred parts* [or 2 fl. oz.] of the menstruum, pack firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the Nux Vomica is exhausted. Reserve the first *one hundred and seventy parts* [or 3½ fl. oz.] of the percolate, distil off the Alcohol from the remainder, and mix the residue with the reserved portion. Place the mixture in an evaporating dish, and, having added

fifty parts [or 1 oz. av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or 2 oz. av.], reduce it to a fine, uniform powder.

Preserve the powder in a well-stopped bottle.

ABSTRACTUM PODOPHYLLI. *U. S.* Abstract of Podophyllum.

	By measure.
Podophyllum, in No. 60 powder, 200 parts, or	4 oz. av.
Sugar of Milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity,	
To make 100 parts, or	2 oz. av.

Moisten the Podophyllum with *eighty parts* [or 1¼ fl. oz.] of Alcohol, and pack firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Podophyllum is exhausted. Reserve the first *one hundred and seventy parts* [or 3½ fl. oz.] of the percolate, distil off the Alcohol from the remainder, and mix the residue with the reserved portion. Place the mixture in an evaporating dish, and, having added *fifty parts* [or 1 oz. av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or 2 oz. av.], reduce it to a fine, uniform powder.

Preserve the powder in a well-stopped bottle.

ABSTRACTUM SENEGÆ. *U. S.* Abstract of Senega.

	By measure.
Senega, in No. 60 powder, 200 parts, or	4 oz. av.
Sugar of Milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity,	
To make 100 parts, or	2 oz. av.

Moisten the Senega with *eighty parts* [or 1¼ fl. oz.] of Alcohol, and pack firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Senega is exhausted. Reserve the first *one hundred and seventy parts* [or 3½ fl. oz.] of the percolate, evaporate the remainder to *thirty parts* [or ½ fl. oz.], at a temperature not exceeding 50° C. (122° F.), and mix with the reserved portion. Place the mixture in an evaporating dish, and, having added *fifty parts* [or 1 oz. av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or 2 oz. av.], reduce it to a fine, uniform powder.

Preserve the powder in a well-stopped bottle.

ABSTRACTUM VALERIANÆ. *U. S.* **Abstract of Valerian.**

	By measure.
Valerian, in No. 60 powder, 200 parts, or	4 oz. av.
Sugar of Milk, recently dried and in fine powder,	
Alcohol, each, a sufficient quantity,	
To make 100 parts, or	2 oz. av.

Moisten the Valerian with *eighty parts* [or 1¼ fl. oz.] of Alcohol, and pack firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Valerian is exhausted. Reserve the first *one hundred and seventy parts* [or 3½ fl. oz.] of the percolate, evaporate the remainder to *thirty parts* [or ½ fl. oz.], at a temperature not exceeding 50° C. (122° F.), and mix with the reserved portion. Place the mixture in an evaporating dish, and, having added *fifty parts* [or 1 oz. av.] of Sugar of Milk, cover it with a piece of thin muslin gauze, and set aside in a warm place, where the temperature will not rise above 50° C. (122° F.), until the mixture is dry. Lastly, having added enough Sugar of Milk to make the mixture weigh *one hundred parts* [or 2 oz. av.], reduce it to a fine, uniform powder.

Preserve the powder in a well-stopped bottle.

Resinæ. *Resins.*

The officinal resins are solid preparations consisting principally of the resinous principles from vegetable bodies, prepared by precipitating them from their alcoholic solution with water. Resins differ from alcoholic extracts in the fact that the latter contain all the principles in the drug which alcohol is capable of dissolving, whilst the resins contain only those principles which are soluble in alcohol and are insoluble in water. It is obvious that the resins prepared from those drugs which owe their activity exclusively to resinous principles, which are insoluble in water, are stronger preparations than the alcoholic extracts from such drugs. Four resins are officinal:

Officinal Resins.

Name.	Preparation.
Resina Copaibæ	By-product, the residue left after distilling off the volatile oil from Copaiba.
Jalapæ	Percolate Jalap, in No. 60 powder, with Alcohol until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the Alcohol, and add the concentrated tincture to water, collect, wash, drain, and dry the precipitate.
Podophylli	Percolate Podophyllum, in No. 60 powder, with Alcohol until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the Alcohol, and add the concentrated tincture to cold water, acidulated with 1 per cent. of Hydrochloric Acid, collect, wash, drain, and dry the precipitate.
Scammonii	Digest Scammony with boiling Alcohol until exhausted, mix the tinctures, distil off the alcohol, add the concentrated tincture to water, wash, drain, and dry the precipitate.

RESINA COPAIBÆ. *U. S.* Resin of Copaiba.

The residue left after distilling off the volatile oil from Copaiba.

A yellowish or brownish-yellow, brittle resin, of a weak odor and taste of copaiba, and an acid reaction. Soluble in alcohol, benzol, or amylic alcohol.

RESINA JALAPÆ. *U. S.* Resin of Jalap.

	By measure.
Jalap, in No. 60 powder, 100 parts, or	16 oz. av.
Alcohol,	
Water, each, a sufficient quantity.	

Moisten the powder with *twenty-five* parts [or 3¾ fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until *two hundred parts* [or 2 pints] of tincture are obtained, or until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the Alcohol, by means of a water-bath, until the tincture is reduced to *forty parts* [or 6½ fl. oz.], and add the latter, with constant stirring, to *nine hundred parts* [or 8 pints] of Water. When the precipitate has subsided, decant the supernatant liquid, and wash the precipitate twice, by decantation, with fresh portions of Water. Place it upon a strainer, and, having pressed out the liquid, dry the Resin with a gentle heat.

Resin of Jalap is partly soluble in ether, and the residue, when dissolved in solution of potassa, is not precipitated by the addition of diluted hydrochloric acid in excess. It is insoluble in disulphide of carbon. One part of the Resin is soluble in 50 parts of warm water of ammonia. On cooling, the solution does not gelatinize, and remains clear after being supersaturated with acids. If the ammoniacal solution is quickly evaporated, the residue is soluble in water.

RESINA PODOPHYLLI. *U. S.* Resin of Podophyllum.

	By measure.
Podophyllum, in No. 60 powder, 100 parts, or	16 oz. av.
Hydrochloric Acid, 1 part, or	1 fl. dr.
Alcohol,	
Water, each, a sufficient quantity.	

Moisten the powder with *forty parts* [or 7 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until *one hundred and fifty parts* [or 1½ pints] of tincture are obtained, or until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the Alcohol, by means of a water-bath, until the tincture is reduced to the consistence of honey, and pour it slowly, with constant stirring, into *one hundred parts* [or 1 pint] of Water, previously cooled to a temperature below 10° C. (50° F.), and

mixed with the Hydrochloric Acid. When the precipitate has subsided, decant the supernatant liquid, and wash the precipitate twice, by decantation, with fresh portions of cold Water. Spread it, in a thin layer, upon a strainer, and dry the resin by exposure to the air, in a cool place.

Resin of Podophyllum is partly soluble in ether, and the residue, when dissolved in solution of potassa, is precipitated by the addition of diluted hydrochloric acid in excess.

RESINA SCAMMONII. *U.S.* Resin of Scammony.

	By measure.
Scammony, in No. 60 powder, 100 parts, or	**16 oz. av.**
Alcohol,	
Water, each, a sufficient quantity.	

Digest the Scammony with successive portions of boiling Alcohol until exhausted. Mix the tinctures, and reduce the mixture to a syrupy consistence by distilling off the Alcohol. Then add the residue to *two hundred and fifty parts* [or 2½ pints] of Water, separate the precipitate formed, wash it thoroughly with Water, and dry it with a gentle heat.

Resin of Scammony is wholly soluble in ether. It dissolves in solution of potassa, and the heated solution is not precipitated by the addition of hydrochloric acid in excess.

CHAPTER XXXI.

SOLID OFFICINAL PREPARATIONS MADE WITHOUT PERCOLATION.

It is not the intention in this chapter to consider *in detail* the classes of solid officinal preparations included in the above title, because their manufacture either belongs to the domain of extemporaneous pharmacy or is intimately connected with it. They are more appropriately treated in the final chapters of the work, because their preparation generally demands a higher degree of skill, and a more intimate knowledge of the physical properties of medicinal substances, than are necessary in making those which have been heretofore considered. For these reasons it has been the author's custom, in lecturing upon the subjects treated of in this work, to reserve the consideration of the solid officinal preparations made without percolation, and those which are embraced under the general term "extemporaneous," until after the student has studied the physical and chemical properties of the various substances which compose the materia medica. It is well for the student to have sufficient knowledge of these preparations to be able to define each class, so that when they are incidentally mentioned in Parts III. and IV. he may be able to describe the use and appearance of a powder, troche, plaster, pill, etc. If it is considered desirable to deviate from this plan, the chapters on these subjects are so constructed that the student may easily turn to them and study them out of the order given here. They will be found in Part VI.

It will be well, however, in this place, in order to keep the classification in view, to enumerate them briefly. They are Pills, Troches, Masses, Confections, Powders, Triturations, Suppositories, Cerates, Ointments, Plasters, and Papers. Among those intended for internal administration pills and troches are largely used, and, because their preparation requires the drugs to be in the form of powder, the classes termed powders and triturations, which are dispensed extemporaneously, are grouped with them. Masses and confections are of course considered in connection with pills, because they are used in their preparation. Suppositories stand alone as a class, whilst cerates, ointments, plasters, and papers form a natural group, being preparations that are used externally.

PART III.

INORGANIC SUBSTANCES.

INTRODUCTORY.

THE various operations and processes which are used in the practice of pharmacy having been treated of in their general relations to one another in the preceding chapters, it is now necessary to consider in detail the physical and chemical properties of the substances that enter into the preparations which are used in medicine.

The plan which will be followed presupposes on the part of the student a knowledge of elementary chemistry, and hence chemical physics, nomenclature, the theoretical construction of formulæ, etc., will not be entered into. The great number of valuable text-books on chemistry, now accessible to every student, renders the introduction of even brief articles on these subjects unnecessary, and the space will be reserved for the consideration of the chemical substances of the materia medica from a pharmaceutical stand-point. For reasons which need not be entered into here, the latest (and to some extent conflicting) views of modern chemists upon the classification of these substances are not adopted, but a method is employed which, whilst it does not do violence to the accepted theories, is simple and practical. The substances are grouped together according to their physical or therapeutical properties, whilst their supposed chemical analogies have not been entirely overlooked. This plan has the merit of giving the student a different view of the chemical substances from that to which he is accustomed in his study of chemistry, and will, perhaps, enhance the interest and impress the points of difference in the substances more forcibly upon the mind.

As an illustration, the chemical properties of the non-metallic elements—Hydrogen, Oxygen, and Nitrogen—will not be noticed at length; they are not recognized articles of the materia medica in their free state; but the acids, bases, and salts containing them are largely used, and they form substances which can be advantageously grouped together for profitable study by the pharmacist.

The table which follows gives the symbols and atomic weights of the elements; those which are of special interest from a pharmaceutical point of view are distinguished from the rest by being printed in heavier type. The revised figures given in the last column are those of Prof. F. W. Clarke.

Table of Elementary Substances.

Element.	Symbol.	Officinal Atomic Weight.	Revised Atomic Weight.
Aluminium	Al	27	27.0090
Antimony	Sb	120	119.9550
Arsenic	As	74.9	74.9180
Barium	Ba	136.8	136.7680
Beryllium (Glucinum)	Be	9	
Bismuth	Bi	210	207.5230
Boron	B	11	10.9410
Bromine	Br	79.8	79.7680
Cadmium	Cd	111.8	111.8350
Cæsium	Cs	132.6	132.5830
Calcium	Ca	40	39.9900
Carbon	C	12	11.9736
Cerium	Ce	141	140.4240
Chlorine	Cl	35.4	35.3700
Chromium	Cr	52.4	52.0090
Cobalt	Co	58.9	58.8870
Copper	Cu	63.2	63.1730
Didymium	Di	144.6	144.5730
Erbium	E	165.9	165.8910
Fluorine	Fl	19	18.9840
Gallium	G	68.8	68.8540
Gold	Au	196.2	196.1550
Hydrogen	H	1	1.0000
Indium	In	113.4	113.3980
Iodine	I	126.6	126.5570
Iridium	Ir	192.7	192.6510
Iron	Fe	55.9	55.9130
Lanthanum	La	138.5	138.5260
Lead	Pb	206.5	206.4710
Lithium	Li	7	7.0073
Magnesium	Mg	24	23.9590
Manganese	Mn	54	53.9060
Mercury	Hg	199.7	199.7120
Molybdenum	Mo	95.5	95.5270
Nickel	Ni	58	57.9280
Niobium	Nb	94	93.8120
Nitrogen	N	14	14.0210
Osmium	Os	198.5	198.4940
Oxygen	O	16	15.9633
Palladium	Pd	105.7	105.7370
Phosphorus	P	31	30.9580
Platinum	Pt	194.4	194.4150
Potassium	K	39	39.0190
Rhodium	Rh	104.1	104.0550
Rubidium	Rb	85.3	85.2510
Ruthenium	Ru	104.2	104.2170
Scandium	Sc	44	43.9800
Selenium	Se	78.8	78.7970
Silicon	Si	28	28.1950
Silver	Ag	107.7	107.6750
Sodium	Na	23	22.9980
Strontium	Sr	87.4	87.3740
Sulphur	S	32	31.9840
Tantalum	Ta	182	182.1440
Tellurium	Te	128	127.9600
Thallium	Tl	203.7	203.7150
Thorium	Th	233	233.4140
Tin	Sn	117.7	117.6980
Titanium	Ti	48	47.9997
Tungsten	W	183.6	183.6100
Uranium	U	238.5	238.4820
Vanadium	V	51.3	51.2560
Ytterbium	Yb	172.7	172.7010
Yttrium	Y	89.8	89.8160
Zinc	Zn	64.9	64.9045
Zirconium	Zr	90	89.3670

CHAPTER XXXII.

HYDROGEN, OXYGEN, AND WATER.

H; 1. O; 16. H_2O; 18.

Hydrogen is a colorless, inodorous, and combustible gas; it is the lightest of all substances. Chemically, it is one of the most important and interesting of the elements, the atomic weights of all being referred to it as unity. Pharmaceutically, in its uncombined state, it is of very little importance, and the reader is referred, for further information, to the chemical text-books.

Oxygen, as usually seen, is a colorless, inodorous gas which aids combustion; it is the most abundant of the elements, forming about one-fifth of the total weight of our atmosphere. Water contains nearly ninety per cent. by weight of oxygen, and it is present in varying quantities in most vegetable and animal substances. The compounds which it forms with other bodies are termed oxides: these are of great pharmaceutical interest, and they will be considered hereafter under their appropriate heads. Oxygen in its free, gaseous condition is sometimes used medicinally, but in this state it is of little importance in pharmacy.

Water is the most important and useful compound known to the pharmacist: its molecule, H_2O, is composed of two parts of hydrogen and one part of oxygen by weight.

The purity of water is specified in the officinal description, which is as follows:

Name.	Description.	Impurities.	Tests for Impurities.
Aqua. *U. S.*	A colorless, limpid liquid, without odor and taste at ordinary temperatures, and remaining odorless while being heated to boiling, of a perfectly neutral reaction, and containing not more than 1 part of fixed impurities in 10,000 parts.	Metallic impurities.	The transparency or color of Water should not be affected by hydrosulphuric acid or sulphide of ammonium.
		More than traces of organic or other oxidizable matters.	On heating 100 C.c. of Water acidulated with 10 C.c. of diluted sulphuric acid, to boiling, and adding enough of a dilute solution of permanganate of potassium (1 in 1000) to impart to the liquid a decided rose-red tint, this tint should not be entirely destroyed by boiling for five minutes.

Uses.—The powers and uses of water as a solvent have been already noticed in the previous chapters. The United States Pharmacopœia directs water, under the name of Aqua, or distilled water, under the

name of Aqua Destillata, to be used in the various processes according to the necessities of the occasion. Ordinary water always contains solid matter and traces of various salts in solution or suspension: these do not unfit it for drinking purposes, but would often seriously interfere with the purity of many chemical substances if such water were used in their preparation. The officinal processes err on the safe side, and direct distilled water in all cases where the use of ordinary water might be injurious or of doubtful propriety. In some sections of the country the drinking-water might be pure enough for the processes, or at least not contain serious impurities; in other sections the water would be totally unfit for the preparations. The purity of officinal distilled water is beyond question, and its use therefore removes all doubts.

For distilled water the tests for purity are, of course, much more exacting.

Aqua Destillata. *U.S.*	Impurities.	Tests for Impurities.
A colorless, limpid liquid, without odor or taste, and of a neutral reaction. On evaporating 1 litre of Distilled Water, no fixed residue should remain.		The transparency or color of Distilled Water should not be affected by any of the following tests:
	Metals.	Hydrosulphuric acid or sulphide of ammonium.
	Sulphate.	Test-solution of chloride of barium.
	Chloride.	Test-solution of nitrate of silver.
	Calcium.	Test-solution of oxalate of ammonium.
	Ammonium Salts, or Free Ammonia.	Test-solution of mercuric chloride, with or without the subsequent addition of carbonate of potassium.
	Organic or other oxidizable matters.	On heating 100 C.c. of Distilled Water, acidulated with 10 C.c. of diluted sulphuric acid, to boiling, and adding enough of a dilute solution of permanganate of potassium (1 in 1000) to impart to the liquid a decided rose-red tint, this tint should not be entirely destroyed by boiling for five minutes, nor by subsequently setting the vessel aside, well covered, for ten hours.

Uses.—Distilled water is used in pharmacy principally as a solvent for delicate chemical salts, and for purposes for which ordinary water is unfitted (see page 251).

CHAPTER XXXIII.

THE INORGANIC ACIDS.

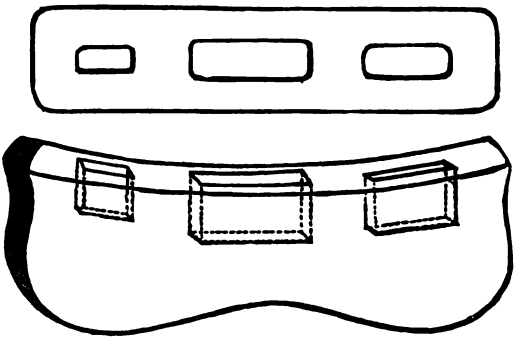
THE inorganic acids form one of the most important classes of compounds used in pharmacy. Acids are distinguished from other bodies by the following properties: 1. They all contain hydrogen, and are sometimes called hydrogen salts. The hydrogen is capable of being replaced by metals. 2. Those which are soluble in water have a characteristic sour taste and corrosive action. 3. They act on litmus and other vegetable substances, changing their color.

The officinal inorganic acids will be considered in the following order: 1. Those which do not contain oxygen or *hydracids*, and which are derived from non-metallic elements,—viz., Hydrochloric and Hydrobromic Acids. 2. The oxygen acids, from non-metallic elements,—Nitric, Nitrohydrochloric, Sulphuric, Sulphurous, and Phosphoric Acids. 3. Those obtained from metallic elements,—Arsenious and Chromic Acids,—and now termed anhydrides, including the weak acid obtained from Boron, will not be treated as acids, but will be described under the headings of the elements from which they are formed.

The names of the acids which contain oxygen vary in their terminations like the salts of certain metals,—the suffixes *ous* and *ic* being used, the former to denote the lower proportion of oxygen, the latter the higher. Thus, sulphur*ous* acid, H_2SO_3, contains less oxygen than sulphur*ic* acid, H_2SO_4; nitr*ous* acid, HNO_2, less than nitr*ic* acid, HNO_3, etc.

Practical Points in Handling Strong Acids.—The strong inorganic acids are never made by the pharmacist for commercial purposes, as they can be manufactured much more economically upon the large scale. They are corrosive in their action, and must be handled very cautiously to avoid personal injury. They are usually sent out by manufacturers in one-pound, or in five-pint, glass-stoppered bottles, or in carboys holding about ten gallons. One of the common annoyances is the liability of the glass stopper to become so tightly fastened in the neck of the bottle that it is

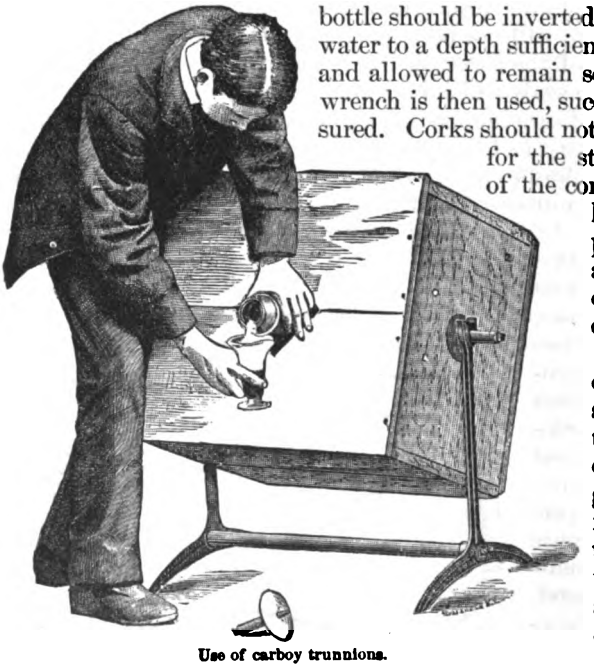
FIG. 331.



Stopper-wrench.

extracted with difficulty. As this always happens with bottles which have well-fitting and hence most valuable stoppers, it becomes an object to extract the stopper without injury. This may frequently be done by grasping the bottle firmly, and, after cleaning off the lute, carefully tapping the stopper *gently* with the *wooden* handle of a pestle or spatula. If very moderate measures do not succeed, the stopper-wrench (see Fig. 331) should be used. This is made of hard wood, of the shape shown in the cut, the upper cut giving the end view and showing the relative sizes of three holes in the wrench. These should be made somewhat larger than the stoppers of the bottles that the wrench is likely to be used for. The lower cut gives the side view of the wrench, which is shaped to fit the hand, and shows the relative depths of the holes. The refractory stopper is placed in the hole, and the operator grasps the wrench with the right hand and endeavors to twist the stopper out. If it does not yield to moderate treatment, the neck of the bottle may be cautiously heated by wrapping it in a cloth wet with hot water, or by means of a spirit-lamp or Bunsen burner with a low flame, passing the flame quickly around it several times so that it shall be uniformly heated. This will cause expansion of the neck, and if the right moment is seized, which is just before the outer surface of the stopper becomes correspondingly heated, the stopper may be easily extracted, the principle of action depending upon unequal expansion. If these means do not succeed, the bottle should be inverted in a vessel of warm water to a depth sufficient to cover the neck, and allowed to remain several hours; if the wrench is then used, success is generally assured. Corks should not be used as stoppers for the strong acids, because of the corrosive action of the latter on them,—a portion of the cork almost invariably contaminating and discoloring the acid.

FIG. 332.



Use of carboy trunnions.

The handling of carboys containing strong acids is sometimes attended with difficulty and danger. The simplest method known to the author is by the use of the trunnions and frame made by J. W. Tufts, of Boston (see Fig. 332). A strong iron frame, which is easily put together, supports the carboy; the trunnions are screwed into the side of the carboy with an ordinary wrench, the proper position for them being slightly above the

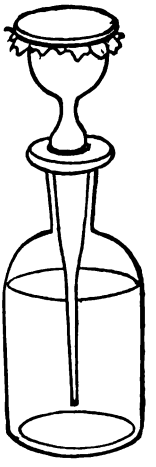
centre of the side. The cut shows the method of using, rendering further description unnecessary.

Quality of Commercial Acids.—Two grades of acids are found in commerce. The first is designated as C. P. (chemically pure), and this is the quality indicated by the U. S. Pharmacopœia to be used in making preparations and for tests, etc. The lower grade is sometimes known as medicinally pure, and is intended to be employed in the arts and for common uses.

Too much importance cannot be attached to the duty of securing pure and strong acids. The introduction of full and reliable tests in the Pharmacopœia of 1880 leaves the pharmacist without excuse if he neglects their careful examination. They are used in many of the qualitative and quantitative officinal tests. If the reagent used for testing is impure itself, the substance which is suspected and is being tested will fall under condemnation when it may be absolutely faultless. Then, again, loss and annoyance in making many preparations, like the iron salts and solutions, will surely follow the use of acids deficient in strength and purity.

Strength of the Officinal Acids.—The officinal inorganic acids are mostly solutions of gaseous acids in water, and no uniformity is to be found among them in the amount of water contained in the strong acids. For instance, hydrochloric acid contains 31.9 per cent. of gaseous hydrochloric acid; nitric acid contains 69.4 per cent. of gaseous nitric acid; and sulphuric acid contains 96 per cent. of absolute sulphuric acid. On the other hand, the *diluted* acids are intended to be uniform,—diluted hydrochloric, nitric, and sulphuric acids each containing 10 per cent. of absolute acid.

FIG. 333.



Acid-dropper.

Medical Properties.—The inorganic acids are generally tonic and refrigerant when administered in a diluted condition; externally, if applied undiluted, they are caustic and corrosive, and should be used with the greatest care. Brushes made of spun glass are sometimes employed to apply strong acids externally to ulcers. Test-bottles with elongated stoppers, or the bottle shown in Fig. 333, are also advantageously used. One of the principal difficulties attendant upon the internal administration of acids is their injurious action upon the teeth. To avoid the destructive contact with the enamel, the diluted acid should be sucked through a narrow glass tube.

Antidotes.—The strong acids are sometimes accidentally taken internally in poisonous doses: their corrosive action is rapidly manifested, and dangerous results may be justly apprehended. *Mild* alkalies in large doses should be at once administered in connection with some bland fixed oil. Lime liniment is usually upon the shelf already prepared, and valuable time may often be saved by at once giving it to the patient in large doses. Soap or either of the carbonates of sodium in dilute solution may be given.

Officinal Inorganic Acids.

Name.	Sp. Gr.	Composition.
Hydracids.		
Acidum Hydrochloricum	1.160	31.9 per cent. HCl.
" Hydrochloricum Dilutum	1.049	10 per cent. HCl.
" Hydrobromicum Dilutum	1.077	10 per cent. HBr.
Oxyacids.		
Acidum Nitricum	1.420	69.4 per cent. HNO_3.
" Nitricum Dilutum	1.059	10 per cent. HNO_3.
" Nitro-Hydrochloricum		4 parts Nitric Acid. 15 parts Hydrochloric Acid.
" Nitro-Hydrochloricum Dilutum		4 parts Nitric Acid. 15 parts Hydrochloric Acid. 76 parts Distilled Water.
" Sulphuricum	1.840	96 per cent. H_2SO_4.
" Sulphuricum Dilutum	1.067	10 per cent. H_2SO_4.
" Sulphuricum Aromaticum	.955	200 parts Sulphuric Acid. 45 parts Tincture of Ginger. 1 part Oil of Cinnamon. 754 parts Alcohol.
" Sulphurosum	1.023	3.5 per cent. SO_2.
" Phosphoricum	1.347	50 per cent. H_3PO_4.
" Phosphoricum Dilutum	1.057	10 per cent. H_3PO_4.
" Boricum		H_3BO_3 (Boracic Acid).
Anhydrides or Oxides.		
Acidum Arseniosum		As_2O_3, Arsenious Oxide.
" Chromicum		CrO_3, Chromic Anhydride.

ACIDUM HYDROCHLORICUM. *U.S.* Hydrochloric Acid.

[ACIDUM MURIATICUM, *Pharm.* 1870.]

A liquid composed of 31.9 per cent. of absolute Hydrochloric Acid [HCl; 36.4] and 68.1 per cent. of water.

Preparation.—Hydrochloric acid, the only known compound of chlorine and hydrogen, is made on a very large scale both abroad and in this country. It is obtained most cheaply as a by-product resulting from the manufacture of soda-ash, by decomposing common salt heated to a high temperature with sulphuric acid. Sulphate of sodium is formed, and gaseous hydrochloric acid is liberated. The latter is conducted into a tall tower filled with coke, called a coke-scrubber; the ascending gas is met by a descending flow of water, which trickles from a reservoir near the top. The gas readily dissolves in the water, and the relative quantities are so arranged that a strong solution passes out at the bottom of the tower. A purer product is formed by selecting the chloride of sodium and sulphuric acid and using a series of stone-ware jars shaped like Woulfe's bottles. About 120 parts of the salt require 100 parts of strong sulphuric acid. Two steps in the process are recognized. In the first reaction but one-half of the chloride of sodium is decomposed, the decomposition of the remainder being effected at a temperature of 220° C. (428° F.) or over. The reaction is thus shown:

$$\underset{\text{Sodium Chloride.}}{2NaCl} + \underset{\text{Sulphuric Acid.}}{H_2SO_4} = \underset{\text{Hydrochloric Acid.}}{HCl} + \underset{\text{Sodium Chloride.}}{NaCl} + \underset{\text{Acid Sodium Sulphate.}}{NaHSO_4},$$

and the residue, when heated, yields the rest of the hydrochloric acid, as follows:

$$\underset{\text{Sodium Chloride.}}{NaCl} + \underset{\text{Acid Sodium Sulphate.}}{NaHSO_4} = \underset{\text{Hydrochloric Acid.}}{HCl} + \underset{\text{Sodium Sulphate.}}{Na_2SO_4}.$$

Hydrochloric acid, or, more properly, solution of hydrochloric acid, is used in pharmacy to make the officinal preparations of the diluted hydrochloric acid, nitrohydrochloric acid, and diluted nitrohydrochloric acid, in the preparation of chlorine water, chlorides, and many other compounds. The yellow color of the common acid is generally due to organic substances or a trace of iron; the white fumes produced when the acid is exposed to the air are caused by the gaseous acid combining with the moisture in the air, and also with a trace of ammonia usually present, forming chloride of ammonium. The officinal description and tests are as follows:

Acidum Hydrochloricum. *U.S.*	Odor, Taste, and Reaction.	Solubility.
A colorless, fuming liquid. By heat it is completely volatilized. Sp. gr. 1.16.	Pungent, suffocating odor; intensely acid taste; strongly acid reaction.	Miscible in all proportions with water and alcohol.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
On heating it with black oxide of manganese, an abundance of chlorine gas is given off.	Iron or much Lead.	If 1 C.c. of the Acid be diluted with water to 10 C.c., and slightly supersaturated with water of ammonia, no precipitate should be formed on gently warming.
	Copper.	The liquid should not have a blue tint.
To neutralize 3.64 Gm. of the Acid should require 31.9 C.c. of the volumetric solution of soda.	Lead and Iron.	And the further addition of 2 drops of test-solution of sulphide of ammonium should not cause a black coloration.
	Non-volatile Metals.	The remaining liquid should leave no fixed residue on evaporation and gentle ignition.
	Chlorine.	When diluted with 5 volumes of water, it should not liberate iodine from test-solution of iodide of potassium.
	Sulphuric Acid.	Nor should 10 C.c. of the diluted Acid be precipitated within five minutes after the addition of 20 drops of test-solution of chloride of barium.
	Sulphurous or Arsenious Acid.	If another portion of the diluted acid be treated with test-zinc, the evolved gas should not blacken paper wet with test-solution of nitrate of silver.

ACIDUM HYDROCHLORICUM DILUTUM. *U.S.* **Diluted Hydrochloric Acid.**

[Acidum Muriaticum Dilutum, *Pharm.* 1870.]

	By measure.
Hydrochloric Acid, 6 parts, or	5½ fl. oz.
Distilled Water, 18 parts, or	14 fl. oz.

Mix the acid with the water, and preserve the product in glass-stoppered bottles.

A colorless liquid, containing 10 per cent. by weight of absolute hydrochloric acid.

The officinal test of strength is as follows:

To neutralize 7.28 Gm. of Diluted Hydrochloric Acid should require 20 C.c. of the volumetric solution of soda.

The tests for impurities are those of hydrochloric acid.

Uses.—Diluted hydrochloric acid is used as a refrigerant and tonic, in doses of fifteen to thirty minims, largely diluted with water. It should be sucked through a glass tube or a straw, to avoid injury to the teeth.

ACIDUM HYDROBROMICUM DILUTUM. *U. S.* Diluted Hydrobromic Acid.

A liquid composed of 10 per cent. of absolute Hydrobromic Acid [HBr; 80.8] and 90 per cent. of water.

Preparation.—Two methods are generally used for making this preparation,—one by distillation, the other by double decomposition and precipitation. The former method yields the purer product, the latter is the more convenient. For other methods of preparation, see U.S. Dispensatory, 15th ed., p. 63.

Diluted Hydrobromic Acid (*Distillation Process*).—Take of Bromide of Potassium and Sulphuric Acid, each, 150 parts, Distilled Water, a sufficient quantity. Add the Sulphuric Acid to 25 parts of Distilled Water, and cool the mixture. Then dissolve the Potassium Bromide in 150 parts of water by the aid of heat, supplying the loss of water by evaporation during the heating. Carefully pour the diluted Sulphuric Acid into the hot solution with constant stirring, and set the mixture aside for twenty-four hours, in order that the Potassium Sulphate may crystallize. Pour off the liquid into a retort, break up the crystalline mass, transfer it to a funnel, and, having drained the crystals, drop slowly upon them 50 parts of cold Distilled Water so as to wash out the acid liquid. Add this liquid to that in the retort, and distil nearly to dryness at a moderate heat. If red fumes of bromine are given off during any stage of the distillation, change the receiver as soon as such fumes cease to appear. Finally determine in the distillate the amount of actual Hydrobromic Acid (16.2 Gm. should require 20 C.c. of the volumetric solution of soda), and add to the remaining weighed distillate such an amount of cold Distilled Water as shall cause the finished acid to contain 10 per cent. of actual Hydrobromic Acid.

This process is based upon that proposed by Dr. E. R. Squibb, the acid preferred by him having, however, the strength of 34 per cent. instead of 10 per cent.

$$\underset{\text{Potassium Bromide.}}{KBr} + \underset{\text{Sulphuric Acid.}}{H_2SO_4} = \underset{\text{Acid Potassium Sulphate.}}{KHSO_4} + \underset{\text{Hydrobromic Acid.}}{HBr.}$$

Diluted Hydrobromic Acid (*Precipitation Process*).—Dissolve 340 grains of Bromide of Potassium in 4 fluidounces of Water, add 400 grains of Tartaric Acid to the solution, cool the mixture tc 40° F., allowing it to stand without agitation as long as possible before pouring off the clear solution from the precipitated acid Tartrate of Potassium. If it can be kept in a cool place for several weeks before it is used, it will

be improved: it will contain about 10 per cent. of absolute hydrobromic acid. This method is a modification of Wade's and Fothergill's processes, and has the advantage of separating the acid tartrate of potassium more effectually. The crystals which form upon the bottom and sides of the bottle act as nuclei, and in time serve to abstract all of the acid tartrate from the liquid.

Acidum Hydrobromicum Dilutum. *U.S.*	Odor, Taste, and Reaction.	Solubility.
A clear, colorless liquid. By heat completely volatilized. Sp. gr. 1.077.	Odorless; strongly acid taste; acid reaction.	Miscible in all proportions with water and alcohol.

Tests for Identity and Quantitative Test.	Impurities.	Test for Impurities.
On adding chlorine or nitric acid to Diluted Hydrobromic Acid, bromine is liberated, which is soluble in chloroform or in disulphide of carbon, imparting to these liquids a yellow color. Test-solution of nitrate of silver causes a white precipitate, insoluble in nitric acid and in water of ammonia, and sparingly soluble in stronger water of ammonia. To neutralize 16.2 Gm. of Diluted Hydrobromic Acid should require 20 C.c. of the volumetric solution of soda.	Bromine.	On being kept for some time, the Acid should not become colored.
	Sulphuric Acid.	Test-solution of chloride of barium should not produce a turbidity or precipitate.

Uses.—Diluted hydrobromic acid is used as a nervine and hypnotic, in doses of two fluidrachms.

ACIDUM NITRICUM. *U.S.* Nitric Acid.

A liquid composed of 69.4 per cent. of absolute Nitric Acid [HNO_3; 63] and 30.6 per cent. of Water.

Preparation.—Nitric acid is prepared from N_2O_5, one of the five compounds of nitrogen and oxygen: these are nitrogen monoxide, or hyponitrous oxide (laughing gas), N_2O; nitrogen dioxide, N_2O_2 or $(NO)_2$; nitrous oxide, N_2O_3; nitrogen tetroxide or peroxide, N_2O_4; and nitric oxide, N_2O_5. From this latter, by the addition of water, nitric acid is formed: $N_2O_5 + H_2O = (HNO_3)_2$. Nitric acid is prepared commercially by reacting on sodium nitrate or Chili saltpetre with sulphuric acid. Sodium nitrate is preferred as the source, because it is cheaper than potassium nitrate, and, in addition, it affords a larger yield of nitric acid. If two molecules of the sodium salt and one of sulphuric acid be taken, the reactions will be as follows:

$$\underset{\text{Sodium Nitrate.}}{NaNO_3} + \underset{\text{Sulphuric Acid.}}{H_2SO_4} = \underset{\text{Acid Sodium Sulphate.}}{NaHSO_4} + \underset{\text{Nitric Acid.}}{HNO_3}.$$

Then, by raising the heat, the acid sodium sulphate acts upon the second molecule of sodium nitrate:

$$\underset{\text{Sodium Nitrate.}}{NaNO_3} + \underset{\text{Acid Sodium Sulphate.}}{NaHSO_4} = \underset{\text{Sodium Sulphate.}}{Na_2SO_4} + \underset{\text{Nitric Acid.}}{HNO_3}.$$

The specific gravity of the officinal acid, or, as it is technically termed, 43° acid, is 1.42 That which is usually furnished in commerce

is not so strong as this, but has the specific gravity of 1.355, and is known as 38° acid. Care should always be observed to specify, in ordering from the manufacturing chemist or dealer, the specific gravity of the acid desired; for if preparations are to be made like the officinal solutions of iron, success cannot be expected if acids of officinal strength are not used. The reddish acid, called *nitrous acid*, is nitric acid containing more or less nitrogen tetroxide (N_2O_4). The same acid may be formed by impregnating nitric acid with nitrogen dioxide (N_2O_2).

Acidum Nitricum. *U.S.*	Odor, Taste, and Reaction.	Solubility.
A colorless, fuming, very caustic and corrosive liquid. Sp. gr. 1.420.	Peculiar, somewhat suffocating odor; strongly acid.	Miscible in all proportions with water or alcohol.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
By heat it is completely volatilized. It dissolves copper with evolution of red vapors, and stains woollen fabrics and animal tissues a bright yellow. To neutralize 3.15 Gm. of Nitric Acid should require 34.7 C.c. of the volumetric solution of soda.	Iron or much Lead.	If 1 C.c. of Nitric Acid be treated with a slight excess of water of ammonia, no precipitate should be formed.
	Copper.	The liquid should not have a blue tint.
	Lead and Iron.	The further addition of 2 drops of test-solution of sulphide of ammonium should not cause a black precipitate.
	Non-volatile Metals.	The remaining liquid should leave no fixed residue on evaporation and gentle ignition.
	Sulphuric Acid.	A portion diluted with 5 volumes of water should afford no precipitate with test-solution of chloride of barium.
	Hydrochloric Acid.	Or with test-solution of nitrate of silver.
	Arsenic Acid.	If 1 part of Nitric Acid be neutralized with solution of potassa, 2 parts of potassa then added, and the mixture boiled with test-zinc, a gas is evolved which should not blacken paper wet with test-solution of nitrate of silver.
	Free Iodine.	If 5 C.c. of Nitric Acid are diluted with an equal volume of water, no blue color should be produced by the addition of a few drops of gelatinized starch.
	Iodic Acid.	Nor should the further addition, without agitation, of a layer of solution of hydrosulphuric acid cause a blue zone at the line of contact of the two liquids.

Uses.—Nitric acid, sometimes called *aqua fortis*, is used in pharmaceutical operations to form nitrates and as an oxidizing agent. Free nitric acid, however, will evolve oxygen at a red heat, according to the following reaction:

$$\underset{\text{Nitric Acid.}}{4HNO_3} = \underset{\substack{\text{Nitrogen}\\\text{Tetroxide.}}}{(N_2O_4)_2} + \underset{\text{Oxygen.}}{O_2} + \underset{\text{Water.}}{(H_2O)_2}.$$

It oxidizes sulphur and phosphorus, giving rise to sulphuric and phosphoric acids, and all the metals, with a few exceptions. It combines with salifiable bases and forms nitrates. Medicinally, nitric acid, when taken internally in doses of five to ten minims, largely diluted, is tonic, antiseptic, and astringent; when applied to the skin it is escharotic, producing a yellow stain, due to the formation of *xantho-proteic acid*.

ACIDUM NITRICUM DILUTUM. *U.S.* **Diluted Nitric Acid.**

	By measure.
Nitric Acid, 1 part, or	1½ fl. oz.
Distilled Water, 6 parts, or	12½ fl. oz.
	14 fl. oz.

Mix the Acid with the Water, and preserve the product in glass-stoppered bottles.

Diluted nitric acid contains about 14.3 per cent. of officinal nitric acid, corresponding to 10 per cent. of absolute nitric acid. Sp. gr. 1.059. The officinal test of strength is that 12.6 Gm. of diluted nitric acid should require 20 C.c. of the volumetric solution of soda to neutralize it.

Uses.—It is used medicinally for the same purposes as the strong nitric acid; when taken internally, the dose is twenty minims.

ACIDUM NITROHYDROCHLORICUM. *U.S.* **Nitrohydrochloric Acid.**

	By measure.
Nitric Acid, 4 parts, or	3 fl. oz.
Hydrochloric Acid, 15 parts, or	13½ fl. oz.
	16½ fl. oz.

Mix the Acids in a capacious open glass vessel, and, when effervescence has ceased, pour the product into glass-stoppered bottles, which should not be more than half filled, and keep them in a cool place.

When nitric acid is mixed with hydrochloric acid, mutual decomposition takes place, according to the reaction

$$\underset{\text{Nitric Acid.}}{HNO_3} + \underset{\text{Hydrochloric Acid.}}{3HCl} = \underset{\text{Nitrosyl Chloride.}}{NOCl} + \underset{\text{Chlorine.}}{Cl_2} + \underset{\text{Water.}}{2H_2O},$$

and a liquid is formed, capable of dissolving gold, called *aqua regia.*

The value of this acid depends upon the completion of the above reaction and the production of nitrosyl chloride and free chlorine. It should be kept in a cool dark place, on account of its liability to lose chlorine by heat, and to have its chlorine converted into hydrochloric acid by the action of light and the decomposition of water. On account of its tendency to decomposition, it should not be made in large quantities, nor be kept on hand very long; care should be taken not to transfer it to the bottle in which it is to be dispensed, until effervescence has ceased, lest the pressure within should drive out the stopper or cause the bottle to explode violently.

Nitrohydrochloric acid is a golden-yellow, fuming, and very corrosive liquid, having a strong odor of chlorine and a strongly acid reaction. By heat it is wholly volatilized. It readily dissolves gold leaf, and a drop added to test-solution of iodide of potassium liberates iodine abundantly.

Uses.—Nitrohydrochloric acid, or, as it is still called, nitromuriatic acid, is given internally in hepatic affections, in doses of three minims and upwards, well diluted with water. Great care should be taken in dispensing this acid, particularly if directed in combination with infu-

sions, tinctures, etc.: the reaction occurring upon mixing should be permitted to cease entirely before dispensing, or an explosion will probably occur when the preparation is in the hands of the patient.

ACIDUM NITROHYDROCHLORICUM DILUTUM. *U. S.* **Diluted Nitrohydrochloric Acid.**

	By measure.
Nitric Acid, 4 parts, or	3 fl. dr.
Hydrochloric Acid, 15 parts, or	13½ fl. dr.
Distilled Water, 76 parts, or	10 fl. oz.
To make about	12 fl. oz.

Mix the Acids in a capacious, open glass vessel, and, when effervescence has ceased, add the Distilled Water. Keep the product in glass-stoppered bottles, in a cool place.

Diluted nitrohydrochloric acid is a colorless or faintly yellow liquid, odorless or having a faint odor of chlorine, and a very acid taste and reaction. By heat it is wholly volatilized. On adding a few drops to test-solution of iodide of potassium, iodine is liberated.

It should be made strictly according to the officinal directions. The acids must be mixed whilst concentrated, otherwise the nitrosyl chloride and chlorine are not produced. Hence the "rapid method," so frequently used, of mixing the acids and immediately diluting with water, does not produce an officinal preparation, and is reprehensible in practice.

Uses.—Diluted nitrohydrochloric acid is given in doses of ten minims, properly diluted, as a tonic and stimulant to the liver.

ACIDUM SULPHURICUM. *U. S.* **Sulphuric Acid.**

A liquid composed of not less than 96 per cent. of absolute Sulphuric Acid [H_2SO_4; 98] and not more than 4 per cent. of Water.

Preparation.—Sulphuric acid is obtained by burning sulphur or iron pyrites, FeS_2, and allowing the product of combustion, SO_2, to mix with nitrous fumes obtained from the decomposition of sodium nitrate, which change SO_2 into SO_3, and this uniting with steam yields H_2SO_4. If the sulphur were burned by itself, the product would be sulphurous oxide, which contains only two-thirds as much oxygen as sulphuric oxide. The object of the sodium nitrate is to furnish, by its decomposition, the requisite additional quantity of oxygen. To understand the process, it is necessary to remember that several of the oxides of nitrogen have oxidizing power. The reactions are thus expressed:

$$\underset{\text{Sulphurous Oxide.}}{2SO_2} + \underset{\text{Nitrogen Tetroxide.}}{N_2O_4} = \underset{\text{Sulphuric Oxide.}}{2SO_3} + \underset{\text{Nitrogen Dioxide.}}{N_2O_2};$$

then

$$\underset{\text{Nitrogen Dioxide.}}{N_2O_2} + \underset{\text{Oxygen.}}{O_2} = \underset{\text{Nitrogen Tetroxide.}}{N_2O_4};$$

then

$$\underset{\text{Sulphuric Oxide.}}{SO_3} + \underset{\text{Water.}}{H_2O} = \underset{\text{Sulphuric Acid.}}{H_2SO_4};$$

in which the sulphurous oxide, from the burning pyrites or sulphur, is oxidized to sulphuric oxide by the nitrogen tetroxide, which readily parts with two atoms of oxygen to such bodies as sulphurous oxide, and then takes two atoms of oxygen again from the atmosphere, regenerating the original tetroxide. The nitrogen tetroxide thus acts simply as a carrier of atmospheric oxygen, whereby the SO_2 is changed into SO_3. This latter compound then unites with steam to form H_2SO_4, the final product.

This acid is made on an immense scale, the reactions taking place in leaden chambers. Sulphur is used most largely in the United States as the source of production, whilst pyrites are used almost exclusively abroad. As the latter nearly always contain arsenical compounds, the foreign commercial product is contaminated with them.

Acidum Sulphuricum. *U. S.*	Odor, Taste, and Reaction.	Solubility.
A colorless liquid, of an oily appearance. Sp. gr. not below 1.840.	Inodorous; strongly caustic and corrosive; strongly acid reaction.	In water and alcohol in all proportions with evolution of heat.

Tests for Identity and Quantitative Test.	Impurities.	Test for Impurities.
When heated on platinum foil, it is vaporised without leaving a residue. If the Acid be warmed with sugar, it blackens the latter; if diluted with 5 volumes of water, the liquid yields, with test-solution of chloride of barium, a white precipitate insoluble in hydrochloric acid. To neutralize 2.45 Gm. of Sulphuric Acid, diluted with about 10 volumes of water, should require not less than 48 C.c. of the volumetric solution of soda.	Lead.	On pouring the Acid into 4 volumes of alcohol, no precipitate should be formed.
	Nitric Acid.	If there be carefully poured upon sulphuric acid, in a test-tube, a layer of freshly prepared test-solution of ferrous sulphate, no brownish or reddish zone should appear at the line of contact of the two liquids.
	Hydrochloric Acid.	When diluted with 10 volumes of water, no precipitate should be formed by the addition of an aqueous solution of sulphate of silver.
	Lead, Arsenic, Copper.	When diluted with 10 volumes of water, no precipitate should be formed by the addition of an aqueous solution of hydrosulphuric acid.
	Iron.	When diluted with 10 volumes of water, no precipitate should be formed by the addition of an excess of water of ammonia.
	Non-volatile Metals.	When diluted with 10 volumes of water containing excess of ammonia, no fixed residue should be left on evaporation and gentle ignition.
	Arsenious or Sulphurous Acid.	When considerably diluted and treated with test-zinc, it evolves a gas which should not blacken paper moistened with test-solution of nitrate of silver.

Uses.—Sulphuric acid is the most powerful of the officinal inorganic acids. It is employed in making many preparations, mostly on account of its energetic action in decomposing salts, and the large use made of its compounds with metals, alkaloids, and other bodies. It is rarely used in the pure state as an escharotic, owing to its tendency to spread. When accidentally dropped upon the skin, a quick and profuse application of magnesia will prove effective. Unless the quantity of acid is very small, care should be used in applying water, except when a very

large quantity can be applied at once, as the amount of heat produced when water is mixed with sulphuric acid would increase the pain. Internally, sulphuric acid is administered either in its diluted form or as aromatic sulphuric acid.

ACIDUM SULPHURICUM AROMATICUM. *U. S.* **Aromatic Sulphuric Acid.**

	By measure.
Sulphuric Acid, 200 parts, or	2 fl. oz.
Tincture of Ginger, 45 parts, or	1 fl. oz.
Oil of Cinnamon, 1 part, or	8 minims.
Alcohol, a sufficient quantity,	
To make 1000 parts, or	20 fl. oz.

Add the Sulphuric Acid gradually to *seven hundred parts* [or 14 fl. oz.] of Alcohol, and allow the mixture to cool. Then add to it the Tincture of Ginger and the Oil of Cinnamon, and afterwards enough Alcohol to make the product weigh *one thousand parts* [or measure 20 fl. oz.].

On diluting 9.8 Gm. of Aromatic Sulphuric Acid with 20 volumes of water, and filtering, the filtrate (with washings) should require, for complete neutralization, not less than 36 C.c. of the volumetric solution of soda. Aromatic Sulphuric Acid contains 20 per cent. of officinal sulphuric acid, and has the specific gravity .955.

Uses.—This preparation, known as *elixir of vitriol*, and largely used, is employed principally as a remedy in the night-sweats of phthisis. It is used somewhat as an excipient for quinine pills, to reduce their size and render them more soluble. The introduction of the acid sulphate of quinine has diminished this use. Its employment in the preparation of infusion of cinchona is to aid in the extraction of the alkaloids.

ACIDUM SULPHURICUM DILUTUM. *U. S.* **Diluted Sulphuric Acid.**

	By measure.
Sulphuric Acid, 1 part, or	1 fl. oz.
Distilled Water, 9 parts, or	16½ fl. oz.

Pour the Acid gradually, with constant stirring, into the Distilled Water, and preserve the product in glass-stoppered bottles. Diluted Sulphuric Acid contains 10 per cent. of officinal Sulphuric Acid, and has the specific gravity 1.067 nearly. To neutralize 9.8 Gm. of Diluted Sulphuric Acid should require 19.2 to 20 C.c. of the volumetric solution of soda.

The strong acid is added gradually to the water, to guard against the too sudden production of heat, which might cause the fracture of a glass vessel. During the dilution, when commercial sulphuric acid is used, the liquid becomes slightly turbid, and in the course of a few days deposits a grayish-white powder, which is sulphate of lead, and from which the diluted acid should be poured off.

The formation of this precipitate does not occur if officinal or chemically pure sulphuric acid is used. The lead salt is present only in sulphuric acid which has not been purified.

Uses.—Diluted sulphuric acid has the same properties as the acid from which it is made, except those which are dependent upon the strength of the latter. It is given internally, properly diluted, in doses of ten to twenty minims.

ACIDUM SULPHUROSUM. *U. S.* Sulphurous Acid.

A liquid composed of about 3.5 per cent. of Sulphurous Acid Gas [SO_2; 64] and about 96.5 per cent. of Water.

	By measure.
Sulphuric Acid, 14 parts, or	5 fl. oz.
Charcoal, in coarse powder, 2 parts, or	1¼ oz. av.
Distilled Water, 100 parts, or	4 pints.

Pour the Acid upon the Charcoal, which has been previously introduced into a glass flask, and mix the two well together. By means of a glass tube and well-fitting corks, connect the flask with a wash-bottle, which is one-third filled with water, and fitted with a cork having three perforations. Into one of these perforations insert a safety-tube, which should reach nearly to the bottom of the bottle; into the remaining perforation fit a glass tube, and connect it with a bottle which is about three-fourths filled by the Distilled Water. This tube should dip about an inch below the surface of the water. By means of a second tube connect this bottle with another bottle containing a dilute solution of carbonate of sodium, to absorb any gas which may not be retained by the Distilled Water. Having ascertained that all the connections are air-tight, apply a moderate heat to the flask until the evolution of gas has nearly ceased, and, during the passage of the gas, keep the bottle containing the Distilled Water at or below 10° C. (50° F.) by surrounding it with cold water or ice. Finally, pour the Sulphurous Acid into glass-stoppered, dark amber-colored bottles, and keep them in a cool and dark place.

The reactions which take place are simple. When the sulphuric acid (H_2SO_4) and charcoal are heated together, two molecules of the former each give up an atom of oxygen to the latter, and there are thus produced sulphurous and carbonic acid gases, which, having been first passed through a wash-bottle containing a little water to absorb impurities, are received into the distilled water, where the sulphurous acid is absorbed, whilst the greater part of the carbonic acid gas escapes.

$$\underset{\text{Sulphuric Acid.}}{4H_2SO_4} + \underset{\text{Carbon.}}{C_2} = \underset{\text{Sulphurous Acid.}}{4SO_2} + \underset{\text{Carbon Dioxide.}}{2CO_2} + \underset{\text{Water.}}{4H_2O}.$$

The mounted flask figured on page 120 is well adapted for preparing sulphurous acid (the thermometer may be omitted). The wash-bottle illustrated upon page 172 can be used in lieu of the bottle directed in the officinal formula: as the generation of the gas progresses, the liquid in the wash-bottle accumulates. Care must be observed in making sulphurous acid to disconnect the wash-bottle from the tube leading to the flask the instant the gas ceases to come over, otherwise a portion of the liquid in the wash-bottle will be sucked into the flask by the partial vacuum produced, almost certainly involving fracture of the flask.

Acidum Sulphurosum. *U.S*	Odor, Taste, and Reaction.	Solubility.
A colorless liquid, of sp. gr. 1.022 –1.023.	Characteristic odor of burning sulphur; very acid sulphurous taste; strongly acid reaction.	Miscible in all proportions with water and alcohol.

Tests for Identity and Quantitative Test.	Impurities.	Test for Impurities.
By heat it is completely volatilized. Litmus-paper brought in contact with the Acid is at first turned red, and afterward bleached. On pouring a few drops of the Acid into a test-tube containing diluted hydrochloric acid and some test-zinc, a gas is evolved which blackens paper wet with solution of acetate of lead. If 1.28 Gm. of Sulphurous Acid be diluted with 20 volumes of water and a little gelatinized starch be added, at least 14 C.c. of the volumetric solution of iodine should be required, before a permanent blue tint is developed.	Limit of Sulphuric Acid.	If to 10 C.c. of Sulphurous Acid there be added 1 C.c. of diluted hydrochloric acid, followed by 1 C.c. of test-solution of chloride of barium, not more than a very slight turbidity should be produced.

The officinal quantitative test depends for its action upon the decomposition of a quantity of iodine proportionate to the amount of sulphurous acid present in the sample tested. The iodine is converted into hydriodic acid, which is colorless, whilst the sulphurous acid becomes sulphuric acid: thus, $H_2SO_3 + I_2 + H_2O = 2HI + H_2SO_4$. The gelatinized starch is used simply to show, by the blue color which it assumes, when free iodine is present: this takes place when all the sulphurous acid has been decomposed.

Uses.—Sulphurous acid is principally used to prevent the growth of the microscopic organisms which induce fermentation. Internally, it is rarely administered, its salts, the sulphites, being preferred. The dose is from three minims to one fluidrachm, diluted with water.

ACIDUM PHOSPHORICUM. *U.S.* Phosphoric Acid.

A liquid composed of 50 per cent. of Orthophosphoric Acid [H_3PO_4; 98] and 50 per cent. of Water.

	By measure.
Phosphorus, 16 parts, or	2 oz. av.
Nitric Acid,	
Distilled Water, each, a sufficient quantity,	
To make 100 parts, or	about 9 fl. oz.

Mix *one hundred parts* [or 8½ fl. oz.] of Nitric Acid with *one hundred parts* [or 9 fl. oz.] of Distilled Water, in a glass retort having the capacity of *four hundred parts* [or 3 pints]. Having placed the retort upon a sand-bath or wire-gauze support, connect it loosely with a well-cooled receiver and add to the acid in the retort the Phosphorus previously cut into fine pieces. Insert a funnel through the tubulure of the retort, and then gradually apply heat until the reaction is seen to commence. Regulate the heat carefully so as to prevent the reaction from becoming too violent, or, if necessary, check it by the addition of a little Distilled Water through the funnel. From time to time return

the acid liquid, which collects in the receiver into the retort, until all the Phosphorus is dissolved. Then transfer the liquid to a weighed porcelain capsule, and continue the heat, at a temperature not exceeding 190° C. (374° F.), until the excess of Nitric Acid is driven off, and an odorless syrupy liquid remains. Cool the dish and contents, and add enough Distilled Water to make the liquid weigh *one hundred parts* [or measure 8¾ fl. oz.]. Test small portions for Nitric, Phosphorous, and Arsenic Acids by the methods given below. If Nitric Acid should be present, evaporate the liquid until no reaction for Nitric Acid can be obtained. Then cool the Acid and add enough Distilled Water to make the product weigh *one hundred parts* [or measure 8¾ fl. oz.]. If Phosphorous Acid be present, add to the liquid a mixture of *six parts* of Nitric Acid and *six parts* of Distilled Water, and again evaporate until no reaction for Phosphorous or Nitric Acid can be obtained. Then, having cooled the Acid, add sufficient Distilled Water to make the product weigh *one hundred parts* [or measure 8¾ fl. oz.]. If Arsenic Acid be present, dilute the Acid with *one hundred and fifty parts* [or 13 fl. oz.] of Distilled Water, heat to about 70° C. (158° F.), and pass through the liquid a stream of Hydrosulphuric Acid Gas for half an hour, then remove the heat and continue passing the gas until the liquid is cold. Close the vessel tightly, set it aside for 24 hours, filter the liquid, heat it until all the odor of the gas has been driven off, again filter, and evaporate until the residue weighs *one hundred parts* [or measures 8¾ fl. oz.]. Preserve the product in glass-stoppered bottles.

The preparation of this acid is not dangerous if the details of the above process are carefully carried out. It is a slow process at best, and all attempts to hasten the action usually result in wasting the phosphorus, by driving off the phosphorous acid or developing a violent action. Upon the large scale, Prof. Markoe's process has been used by the author with good results. (See U. S. Dispensatory, 15th edition, p. 96.)

A modification of this process, which obviates any likelihood of danger, is as follows: Pour 12 fluidounces of distilled water, mixed with 11 fluidounces of nitric acid, into a two-pint flask. Add 40 grains of bromine, and shake it gently until it is dissolved. Now add two ounces of phosphorus, and set the flask aside, where the nitrous vapors may be carried off without injury. In winter-time, or if the acid is needed at once, it will be necessary to aid the reaction by a gentle heat; but if sufficient time can be allowed, the phosphorus will disappear gradually at the ordinary temperature, and no particular attention will be needed until the phosphorus is oxidized. The nearly colorless liquid remaining in the flask is then evaporated, tested for impurities by the officinal method, and diluted to the proper strength.

The rationale of the officinal method is simple, and it affords a good illustration of the use of nitric acid as an oxidizing agent.

$$\underset{\text{Phosphorus.}}{12P} + \underset{\text{Nitric Acid.}}{20HNO_3} + \underset{\text{Water.}}{8H_2O} = \underset{\text{Phosphoric Acid.}}{12H_3PO_4} + \underset{\text{Nitrogen Oxide.}}{20NO.}$$

The most dangerous impurity likely to be found in the finished preparation is arsenic,—its presence being traced to the sulphuric acid made from pyrites, which is used in making the phosphorus.

Acidum Phosphoricum. *U. S.*	Odor, Taste, and Reaction.	Solubility.
A colorless liquid, of the specific gravity 1.347.	Odorless; strongly acid taste; acid reaction.	Miscible in all proportions with water and alcohol.

Tests for Identity and Quantitative Test.	Impurities.	Test for Impurities.
When heated, the liquid loses water, and when a temperature of about 200° C. (392° F.) has been reached, the Acid is gradually converted into pyrophosphoric and metaphosphoric acids, which may be volatilized at a red heat. If the diluted Acid be supersaturated with ammonia, addition of test-mixture of magnesium produces a white, crystalline precipitate. If this precipitate be dissolved in diluted acetic acid, the solution yields a yellow precipitate with test-solution of nitrate of silver.	Phosphorous Acid.	Phosphoric Acid, diluted with 5 volumes of water, and gently warmed, should not be blackened by test-solution of nitrate of silver, nor be turned white or whitish by test-solution of mercuric chloride.
	Arsenic Acid.	When Phosphoric Acid is heated to about 70° C. (158° F.), thoroughly saturated during half an hour, and afterward until it is cold, with hydrosulphuric acid gas, then set aside for twenty-four hours, it should not deposit a lemon-yellow sediment.
	Nitric Acid.	If a crystal of ferrous sulphate be dropped into a cooled mixture of Phosphoric and Sulphuric Acids, no brown or reddish zone should make its appearance around the crystal.
On pouring 5 Gm. of Phosphoric Acid upon 10 Gm. of oxide of lead free from carbonate of lead and from moisture, evaporating and igniting, a residue will be obtained which should weigh 11.81 Gm.	Sulphuric Acid.	After diluting Phosphoric Acid with 5 volumes of distilled water, no precipitate should be produced on the addition of small portions of test-solution of chloride of barium.
	Hydrochloric Acid.	The diluted acid should yield no precipitate with test-solution of nitrate of silver.
	Pyrophosphoric and Metaphosphoric Acids.	Nor should any precipitate be formed, after several hours, by the addition of an equal volume of tincture of chloride of iron.

Uses.—Phosphoric acid, sometimes called "syrupy phosphoric acid," is used almost solely to make the diluted phosphoric acid.

ACIDUM PHOSPHORICUM DILUTUM. *U. S.* **Diluted Phosphoric Acid.**

	By measure.
Phosphoric Acid, 20 parts, or	2½ fl. oz.
Distilled Water, 80 parts, or	13½ fl. oz.
To make 100 parts, or	16 fl. oz.

Mix the Phosphoric Acid with the Distilled Water. Diluted Phosphoric Acid has a specific gravity of 1.057, and contains 10 per cent. of orthophosphoric acid. It should respond to the tests of purity required for Phosphoric Acid. On pouring 5 Gm. of Diluted Phosphoric Acid upon 5 Gm. of oxide of lead free from carbonate and from moisture, evaporating and igniting, a residue will be obtained which should weigh 5.36 Gm.

The precipitation which sometimes occurs when this acid is mixed with tincture of chloride of iron is generally due to the presence of pyrophosphoric acid. Pyrophosphate of iron is precipitated in the form of an insoluble gelatinous precipitate.

Uses.—Diluted phosphoric acid is tonic and refrigerant in doses of twenty minims.

CHAPTER XXXIV.

PREPARATIONS OF THE HALOGENS.

Chlorine, Bromine, and Iodine.

Cl; 35.4. Br; 79.8. I; 126.6.

FOUR elements, *chlorine*, *bromine*, *iodine*, and *fluorine*, are termed halogens (salt-producers). Fluorine is of so little interest in pharmacy that it will not be noticed: the other three are of great interest both to medicine and to pharmacy.

Chlorine. Cl; 35.4.

Chlorine is a greenish-yellow, gaseous body, having a very suffocating odor; its specific gravity is 2.45. Its most useful and characteristic property is that of bleaching organic coloring principles: the presence of water is necessary to effect this object. Chlorine is one of the most reliable disinfectants: it is principally used in combination with lime as bleaching powder, the officinal name being Calx Chlorata.

Chlorine combines with hydrogen and the metals, but has very little attraction for oxygen; its principal hydrogen compound is hydrochloric acid, HCl (see Acidum Hydrochloricum). The compounds of chlorine with metals and bases are termed chlorides: they will be considered under the heads of their respective bases.

Chlorine combines indirectly with oxygen, and the compounds produced by the union of the oxyacid, chloric acid, $HClO_3$, with metals or bases are termed chlorates. Perchlorates are also known.

Tests for Chlorides and Chlorates.

Chlorides in solution, or hydrochloric acid, may be recognized by the addition of a solution of silver nitrate; a curdy white precipitate is produced, which is soluble in water of ammonia, but insoluble in nitric acid.

Chlorates are recognized by the evolution of oxygen when heated, and by the reaction of the residue corresponding with that of chlorides.

Officinal Preparations of Chlorine, Bromine, and Iodine.

Chlorine.—Made by the action of heat upon hydrochloric acid and manganese dioxide.

Aqua Chlori.—An aqueous solution of chlorine containing 0.4 p.c. of the gas.

Chlorine loosely combined.

Calx Chlorata.—Made by subjecting calcium hydrate to the action of chlorine.

Liquor Sodæ Chloratæ.—Made by decomposing solution of chlorinated lime with sodium carbonate.

Bromum (Bromine).—Made by decomposing crude magnesium bromide with chlorine.

Iodum (Iodine).—Made by decomposing crude sodium iodide with manganese dioxide and sulphuric acid and subliming.

Tinctura Iodi.—An 8 p.c. alcoholic solution of iodine.

Liquor Iodi Compositus.—A 5 p.c. aqueous solution of iodine, made soluble by the addition of 10 p.c. of potassium iodide.

Unguentum Iodi.—4 p.c. iodine; 1 p.c. potassium iodide; 2 p.c. water, with benzoinated lard.

Iodine loosely combined.

Amylum Iodatum.—5 p.c. iodine triturated with starch.

Syrupus Acidi Hydriodici.—1 p.c. syrupy solution of hydriodic acid.

Unofficinal Preparations of Chlorine, Bromine, and Iodine.

Acidum Hypochlorosum, HClO. Hypochlorous Acid.	Agitate chlorine water with precipitated mercuric oxide. Distil the liquid to remove mercuric chloride, and collect the distillate.
Acidum Chloricum, $HClO_3$. Chloric Acid.	Decompose barium chlorate with an equivalent amount of pure diluted sulphuric acid; pour off the clear solution of chloric acid, and evaporate carefully *in vacuo* over strong sulphuric acid.
Acidum Perchloricum, $HClO_4$. Perchloric Acid.	Distil pure dry potassium perchlorate with four times its weight of concentrated (previously boiled) sulphuric acid. Collect the yellow distillate.
Bromii Chloridum. Chloride of Bromine.	Pass chlorine gas over bromine.
Acidum Bromicum. Bromic Acid.	Decompose barium bromate with an equivalent amount of diluted sulphuric acid, filter, and evaporate.
Acidum Hydriodicum, HI. Hydriodic Acid.	See Syrupus Acidi Hydriodici, U.S.P.
Acidum Iodicum, HIO_3, = 175.6. Iodic Acid.	Heat 1 p. iodine with 10 p. of nitric acid in a retort until the iodine is dissolved and fumes cease to be evolved. Evaporate the solution, and heat the residue to 200° F. until all trace of acid is removed. Collect the white powder.
Acidum Periodicum, HIO_4, = 191.6. Periodic Acid.	Add 1 p. iodine to a solution of 7 p. sodium carbonate in 100 p. water, and pass chlorine into the heated liquid until a precipitate ceases to form. Dissolve this precipitate in pure nitric acid, then add silver nitrate, and dissolve the resulting precipitate in hot diluted nitric acid; then concentrate to crystallize. Treat the crystals with water, filter, and evaporate.

Chlorine in its free state is used officinally in aqua chlori, or chlorine water (see page 250).

AQUA CHLORI. *U.S.* Chlorine Water.

Chlorine water is made by heating hydrochloric acid with manganese dioxide, and conducting the generated chlorine into distilled water until a saturated solution is produced: it should contain at least 0.4 per cent. of the gas (see page 250).

$$\underset{\text{Manganese Dioxide.}}{MnO_2} + \underset{\text{Hydrochloric Acid.}}{4HCl} = \underset{\text{Manganese Chloride.}}{MnCl_2} + \underset{\text{Chlorine.}}{Cl_2} + \underset{\text{Water.}}{2H_2O}.$$

The chlorine water must be kept secluded from the light, to prevent its partial conversion into hydrochloric acid through the decomposition of the water by the union of the chlorine with its hydrogen.

Aqua Chlori. *U.S.*	Tests.
A greenish-yellow, clear liquid, having the suffocating odor and disagreeable taste of chlorine, and leaving no residue on evaporation. It instantly decolorizes dilute solutions of litmus and indigo.	On mixing 35.4 Gm. of Chlorine Water with a solution of 0.9 Gm. of iodide of potassium in 20 Gm. of water, the resulting deep-red liquid should require for complete discoloration at least 40 C.c. of the volumetric solution of hyposulphite of sodium (corresponding to at least 0.4 per cent. of Chlorine). When Chlorine Water is shaken with an excess of mercury until the odor of Chlorine has disappeared, the remaining liquid should be at most but faintly acid (limit of hydrochloric acid).

The little apparatus shown in Fig. 211 is well adapted for making small quantities of chlorine water rapidly. Chlorine water is sometimes made extemporaneously by placing three fluidrachms of hydrochloric acid in a pint bottle, adding forty grains of potassium chlorate, and when the bottle is nearly filled with chlorine vapor, adding one fluidounce of distilled water. The bottle should now be stoppered, and, when the crystals have dissolved, sufficient distilled water is added to make one pint. This method is not to be compared in efficiency with the officinal process. The liquid contains free hydrochloric acid and potassium chloride; the explosive gas Cl_2O_4 is generated also, but not in sufficient quantity to be dangerous if the above directions are carefully carried out.

Uses.—Chlorine water is antiseptic and stimulant: it is used as a gargle in scarlet fever, diphtheria, and similar diseases. Chlorine in the gaseous state is largely used as a disinfectant. A convenient way of generating it is by the well-known *chlorine saucer disinfectant:* this is made by pouring half a fluidounce of equal measures of sulphuric acid and water upon two hundred grains of a finely-ground mixture of equal parts of black oxide of manganese and common salt, contained in a saucer. Chlorine is gradually evolved from this mixture for several days. Chlorinated lime and solution of chlorinated soda both owe their properties to the presence of chlorine. They will therefore be considered here.

CALX CHLORATA. *U.S.* Chlorinated Lime.

"A compound resulting from the action of Chlorine upon Hydrate of Calcium, and containing at least 25 per cent. of available Chlorine."

Preparation.—Chlorinated lime—or chloride of lime, as it is more frequently and less properly called—is made by exposing finely-powdered calcium hydrate, which is placed on trays in a suitable chamber, to the action of chlorine. The gas is absorbed by the lime, and a chemical compound is formed, which is represented by the formula $CaOCl_2$. Various views have been held by chemists as to its exact composition, but the weight of opinion is now in favor of considering it to be as above stated, and yielding, by decomposition with water, calcium hypochlorite and calcium chloride. The value of chlorinated lime, whether used for bleaching purposes or in medicine, depends upon the amount of chlorine which can be eliminated; for, whatever view is accepted as to its composition, it is admitted that the chlorine is very loosely combined.

Calx Chlorata. *U.S.*	Tests.
A white or grayish-white, dry, or but slightly damp powder, or friable lumps, becoming moist and gradually decomposing on exposure to air, having a feeble, chlorine-like odor, and a disagreeable, saline taste. It is partially soluble in water and in alcohol. On dissolving Chlorinated Lime in diluted hydrochloric acid, chlorine gas is given off, and there should not remain more than a trifling amount of insoluble matter.	Its solution in diluted acetic acid yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric acid. The aqueous solution quickly destroys the color of a dilute solution of litmus or of indigo. If 0.71 Gm. of Chlorinated Lime be mixed with a solution of 1.25 Gm. of iodide of potassium in 120 C.c. of water, and 9 Gm. of diluted hydrochloric acid be then added, the red-brown liquid should require for complete decoloration not less than 50 C.c. of the volumetric solution of hyposulphite of sodium.

Chlorinated Lime should be preserved in well-closed vessels in a cool or dry place. A very excellent method of preservation is now in vogue, in which the dry chlorinated lime is hermetically sealed in straw-board boxes, which are protected on the inside by a composition coating containing rosin. When exposed to the air it soon becomes moist, on account of the hygroscopic character of the calcium chloride present.

Uses.—Chlorinated lime is used in the preparation of solution of chlorinated soda, but most largely as a disinfectant, through its power of arresting animal and vegetable putrefaction. It is rarely given internally, but is sometimes used as a stimulant and alterative, in doses of three to six grains. Externally, it is used in solution as an application to ulcers, burns, etc.

LIQUOR SODÆ CHLORATÆ. *U.S.* **Solution of Chlorinated Soda.**

	By measure.
Carbonate of Sodium, 100 parts, or	25 oz. av.
Chlorinated Lime, 80 parts, or	20 oz. av.
Water, a sufficient quantity,	
To make 1000 parts, or	14 pints.

Mix the Chlorinated Lime intimately with *four hundred parts* [or 5½ pints] of Water in a tared vessel provided with a tightly fitting cover. Dissolve the Carbonate of Sodium in *four hundred parts* [or 5½ pints] of boiling Water, and immediately pour the latter solution into the former. Cover the vessel tightly, and, when the contents are cold, add enough Water to make them weigh *one thousand parts* [or measure 14 pints]. Lastly, strain the mixture through muslin, allow the precipitate to subside, and remove the clear solution by means of a syphon. Keep the product in well-stopped bottles.

Double decomposition results in the formation of insoluble calcium carbonate or precipitated chalk, whilst sodium hypochlorite and sodium chloride remain in solution.

$$\underset{\text{Chlorinated Lime.}}{Ca(OCl)_2} + \underset{\text{Calcium Chloride.}}{CaCl_2} + \underset{\text{Sodium Carbonate.}}{2Na_2CO_3} = \underset{\text{Sodium Hypochlorite.}}{2NaOCl} + \underset{\text{Sodium Chloride.}}{2NaCl} + \underset{\text{Calcium Carbonate.}}{2CaCO_3}.$$

Liquor Sodæ Chloratæ. *U.S.*	Tests.
A clear, pale greenish liquid, of a faint odor of chlorine, a disagreeable and alkaline taste, and an alkaline reaction. Sp. gr. 1.044. Addition of hydrochloric acid causes an effervescence of chlorine and carbonic acid gas. It rapidly decolorizes indigo, and produces a copious, light brown precipitate with solution of ferrous sulphate.	8.88 Gm. of the Solution, when mixed with a solution of 2.6 Gm. of iodide of potassium in 200 C.c. of water, and afterward with 18 Gm. of hydrochloric acid and a little gelatinized starch, should require, for complete decoloration, not less than 50 C.c. of the volumetric solution of hyposulphite of sodium (corresponding to at least 2 per cent. of available chlorine).

Uses.—Solution of chlorinated soda is principally employed as a disinfectant or bleaching solution: it is frequently termed *Labarraque's Solution*, and is sometimes substituted for *Eau de Javelle* (*Javelle's water*), a French preparation made with potassium carbonate instead of sodium carbonate.

BROMUM. *U.S.* Bromine.

Br; 79.8.

Preparation.—This non-metallic element, which is in the form of a dark red, volatile liquid, is produced largely in the United States, in Ohio, West Virginia, and Pennsylvania. It is prepared from the brine obtained from salt-wells by the following process. The brine is concentrated to separate chlorides, sulphates, etc., by crystallization. The mother-liquor, containing the bromine principally in the form of magnesium bromide, is decomposed by treating it with chlorine gas produced from manganese dioxide and hydrochloric acid.

The manner of conducting this process is peculiar. The original salt-liquor, or brine, is pumped out of the ground and evaporated to about 15° B. in large iron pans, then allowed to settle, and is further evaporated in wooden tanks heated by steam pipes to the point of crystallization. These tanks, five in number, are placed at different elevations, one above the other. Each day the liquor is run off from No. 1, the highest, to No. 2, next day to No. 3, and so on until it reaches No. 5, the crystallized salt being removed from each tank after draining off the liquor. The brine which reaches No. 5 is bittern, and consists chiefly of calcium, magnesium, sodium, and aluminium chlorides, with varying percentages of sodium and calcium bromides.

The bittern marking 30° to 38° B. is evaporated to about 45° B. The liquor is then run into stone stills, materials for generation of chlorine added, and heat applied by means of steam until the bromine has all been vaporized. It is condensed and collected in cooled receivers.

$$\underset{\text{Magnesium Bromide.}}{MgBr_2} + \underset{\text{Chlorine.}}{2Cl} = \underset{\text{Magnesium Chloride.}}{MgCl_2} + \underset{\text{Bromine.}}{2Br.}$$

On account of its very caustic and irritating properties, *great care* must be used in handling bromine. Its vapor is very corrosive and suffocating.

Chemically, there is a close analogy between bromine and chlorine. Its combination with hydrogen is hydrobromic acid, which is officinal (see page 408).

The salts, termed bromides, are used very largely in medicine. They will be considered under the heads of their respective bases. *Bromates*, formed, like chlorates, by combination with the corresponding oxyacid, bromic acid, $HBrO_3$, are rarely used.

Tests.

1. If a solution of a bromide be treated with a solution of silver nitrate, a yellowish-white precipitate of silver bromide is produced, which is insoluble in nitric acid and but slightly soluble in water of ammonia.

2. If chlorine water be added to a strong solution of a bromide, bromine is liberated. This may be dissolved by agitation with carbon disulphide or ether.

3. If concentrated sulphuric acid be added to a bromide (not in solution), reddish vapors of bromine are evolved.

Bromum. *U. S.*	Odor.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A dark brownish-red, mobile liquid, evolving, even at the ordinary temperature, a yellowish-red vapor highly irritating to the eyes and lungs. It boils at 63° C. (145.4° F.). Sp. gr. 2.990.	A peculiar suffocating odor, resembling that of chlorine.	33 parts.	Very soluble, with gradual decomposition of the alcohol.	Very soluble in ether, with gradual decomposition of the ether; very soluble in chloroform and in disulphide of carbon.

Tests for Identity.	Impurities.	Tests for Impurities.
It is completely volatilized by exposure to air or to heat. It destroys the color of litmus and of sulphate of indigo, and renders gelatinized starch yellow.	More than 3 per cent. of Chlorine.	If 3 Gm. of Bromine be mixed with 30 C.c. of water and enough water of ammonia to render the solution colorless, the liquid then digested with carbonate of barium, filtered, evaporated to dryness, and the residue gently ignited, the latter should be soluble in absolute alcohol without leaving more than 0.26 Gm. of residue.
	Iodine.	If an aqueous solution of Bromine be poured upon reduced Iron and shaken with the latter until it has become nearly colorless, then filtered, mixed with gelatinized starch, and a few drops of Bromine solution now carefully poured on top, not more than a very faint blue zone should appear at the line of contact of the two liquids.

Uses.—Bromine is rarely used in its undiluted condition. When diluted with water in the proportion of forty minims in a pint, it forms a powerful wash. It is the important ingredient in *Bibron's antidote* to rattlesnake poison, which is made by dissolving three hundred grains of bromine in half a pint of diluted alcohol, and then placing four grains of potassium iodide and two grains of corrosive chloride of mercury in a mortar; sufficient of the solution is added to dissolve the salts, this being mixed with the rest of the solution.

IODUM. *U. S.* Iodine.

I; 126.6.

Preparation.—Iodine is a non-metallic element widely distributed in nature. It was formerly exclusively obtained from *kelp*, the ashes of certain sea-weeds. In addition to this source, it is now made from the mother-liquors obtained from the crystallization of sodium nitrate in South America. These contain the iodine in the form of sodium iodide and sodium iodate. The iodides are decomposed by chlorine, iodine being set free, whilst the iodine from the iodates is precipitated by treatment with acid sodium sulphite. The liquid obtained by lixiviating kelp contains the iodine as sodium iodide. A concentrated solution of the impure iodide is treated with sulphuric acid, then distilled with manganese dioxide; the separated iodine condenses in a series of glass receivers.

$$\underset{\text{Sodium Iodide.}}{2NaI} + \underset{\text{Sulphuric Acid.}}{2H_2SO_4} + \underset{\text{Manganese Dioxide.}}{MnO_2} = \underset{\text{Iodine.}}{I_2} + \underset{\text{Manganese Sulphate.}}{MnSO_4} + \underset{\text{Sodium Sulphate.}}{Na_2SO_4} + \underset{\text{Water.}}{2H_2O}.$$

Iodine of excellent quality is now readily obtained: the presence of a small quantity of water, however, is often noticed.

Iodum. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Heavy, bluish-black, dry and friable, rhombic plates of a metallic lustre. Iodine imparts a deep brown, slowly evanescing stain to the skin, and slowly destroys vegetable colors.	Distinctive odor; sharp and acrid taste; neutral reaction.	Sparingly soluble.	11 parts.	Very soluble in ether, disulphide of carbon, and chloroform.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
It is slowly volatilized at ordinary temperatures. When heated to 114° C. (237.2° F.) it melts, and then rises in purple vapor, being gradually dissipated without leaving a residue. With gelatinized starch, in a cold solution, it produces a dark blue color. If 0.633 Gm. of Iodine, with 1 Gm. of iodide of potassium, be dissolved in 25 C.c. of water, it should require 50 C.c. of the volumetric solution of hyposulphite of sodium to fully decolorize the liquid (corresponding to 100 per cent. of absolute Iodine).	Moisture.	A solution of Iodine in chloroform should be perfectly clear and limpid.
	Chloride of Iodine.	When shaken with distilled water, it should not communicate to the latter more than a light brownish tinge, and no deep brown color.
	Cyanide of Iodine.	If the Iodine be removed from a dilute aqueous solution by agitation with disulphide of carbon, and, after the separation of the latter, some dilute solution of ferrous sulphate with a trace of ferric chloride be added, finally solution of soda, and the whole supersaturated with hydrochloric acid, no blue precipitate should make its appearance.
	More than traces of Chlorine or Bromine.	If Iodine be dissolved in sulphurous acid, the solution strongly supersaturated with ammonia, and completely precipitated by nitrate of silver, the filtrate, on being supersaturated with nitric acid, should not at once become more than faintly cloudy.

Iodine is closely related chemically to bromine and chlorine. Its combination with hydrogen (hydriodic acid) is officinal as Syrupus Acidi Hydriodici, syrup being necessary to preserve it from decomposition. The iodides are largely used in medicine. The iodates, like the chlorates and bromates, are produced by combination with the oxyacids of iodine, iodic and periodic acids. They are of little interest pharmaceutically.

Tests for Iodine and Iodides.

1. A dark blue color (fading upon the application of heat) is produced when iodine is brought in contact with starch mucilage.

2. An iodide is detected by first liberating the iodine by adding a little chlorine water and then using starch mucilage, or if carbon bisulphide be added the iodine dissolves in it.

3. Silver nitrate produces with a solution of an iodide a yellowish-white precipitate of silver iodide, which is insoluble in nitric acid, and but slightly soluble in water of ammonia.

4. A yellow precipitate of lead iodide is produced by adding a solution of lead-salt to a neutral solution of an iodide.

5. A red precipitate of mercuric iodide is produced by adding a solution of mercuric chloride to a neutral solution of an iodide.

Uses.—Iodine is very largely used in medicine. It excites the action of the absorbent and glandular systems, and is employed both internally and externally.

TINCTURA IODI. *U.S.* Tincture of Iodine.

An 8 per cent. alcoholic solution of Iodine (see page 314), 6.33 Gm. of the Tincture, mixed with a solution of 2 Gm. of iodide of potassium in 25 C.c. of water and a little gelatinized starch, should require, for complete decoloration, 40 C.c. of the volumetric solution of hyposulphite of sodium.

LIQUOR IODI COMPOSITUS. *U.S.* Compound Solution of Iodine.

[LIQUOR IODINII COMPOSITUS, *U.S.* 1870. LUGOL'S SOLUTION.]

Iodine, 5 parts, or	½ oz. av.
Iodide of Potassium, 10 parts, or	1 oz. av.
Distilled Water, 85 parts, or	8 fl. oz. 3 fl. dr.
To make 100 parts, or . . . about	9 fl. oz.

Dissolve the Iodine and Iodide of Potassium in the Distilled Water. Keep the solution in well-stopped bottles.

In this solution iodine is dissolved in water with the assistance of iodide of potassium. Iodine dissolves sparingly in water, but freely in a solution of that salt. In using iodide of potassium to render iodine more soluble in water, the iodide is generally taken in a quantity twice the weight of the iodine. The solution contains about 3.25 grains of iodine in the fluidrachm.

The officinal quantitative test requires that 12.66 Gm. of the Solution, mixed with a little gelatinized starch, should require, for complete decoloration, 50 C.c. of the volumetric solution of hyposulphite of sodium.

Uses.—This solution affords an efficient means of administering iodine internally. It is given in five-minim doses, and, to prevent gastric irritation, it must be largely diluted.

UNGUENTUM IODI. *U.S.* Iodine Ointment.

An ointment containing 4 per cent. of Iodine, 1 per cent. of Iodide of Potassium, 2 per cent. of Water, and 93 per cent. of Benzoinated Lard. (See Unguenta, Part VI.).

AMYLUM IODATUM. *U.S.* Iodized Starch.

Starch, 95 parts, or	418 grains.
Iodine, 5 parts, or	22 grains.
Distilled Water, a sufficient quantity,	
To make 100 parts, or . . . about	1 oz. av.

Triturate the Iodine with a little distilled water, add the starch gradually, and continue triturating until the compound assumes a uniform blue color, approaching black. Dry it at a temperature not exceeding 40° C. (104° F.), and rub it to a fine powder. Iodide of Starch should be preserved in glass-stoppered vials.

It has been asserted by Bondonneau, Payen, Fritzsche, and others that iodine forms with starch a definite compound, and the formulas $(C_6H_{10}O_5)_5I$ and $(C_6H_{10}O_5)_{10}I$ have been assigned to it. The existence of these compounds is regarded as doubtful, however, and the Pharmacopœia terms the mixture iodized starch.

Uses.—Iodized starch is a convenient preparation for administering iodine internally, the principal advantage being that starch forms an admirable diluent, and the iodine is freed from irritant properties. The dose is two to four drachms.

SYRUPUS ACIDI HYDRIODICI. *U.S.* Syrup of Hydriodic Acid.

This is a syrupy liquid containing 1 per cent. of absolute hydriodic acid [HI ; 127.6], having the specific gravity 1.300. It is made by adding an alcoholic solution of iodine to syrup, and passing through the mixture hydrosulphuric acid gas, until the color of iodine is discharged. The liquid is filtered, and the filtrate evaporated at a low temperature, until all odor of hydrosulphuric acid has disappeared. When cold, the liquid is flavored with spirit of orange, and further sweetened by the addition of sugar (see page 259). The object of this preparation is to furnish an agreeable mode of administering hydriodic acid, and also a liquid which will be reasonably stable. *Hydriodic acid*, HI, is easily decomposed in simple aqueous solution, free iodine being liberated, and if taken internally when in this condition, serious results might follow. The chemical reaction which takes place when hydrosulphuric acid is passed into a solution containing iodine may be expressed as follows:

$$\underset{\text{Iodine.}}{4I} + \underset{\substack{\text{Hydrosulphuric}\\\text{Acid.}}}{2H_2S} = \underset{\substack{\text{Hydriodic}\\\text{Acid.}}}{4HI} + \underset{\text{Sulphur.}}{2S}.$$

Uses.—Syrup of hydriodic acid is used as an alterative and antipyretic. The dose is twenty to forty minims.

CHAPTER XXXV.

SULPHUR AND PHOSPHORUS.

S; 32. P; 31.

THESE two elements furnish many important compounds to medicine. They present several analogies, both physically and chemically.

Officinal Preparations of Sulphur and Phosphorus.

Sulphur Sublimatum.—Made by subliming crude sulphur.
Sulphur Lotum.—Made by washing sublimed sulphur.
Sulphur Præcipitatum.—Made by precipitating a solution of calcium disulphide with HCl.
Sulphuris Iodidum.—Made by heating iodine with sulphur.
Unguentum Sulphuris.—Made by mixing 30 parts of sublimed sulphur with 70 parts of benzoinated lard.
Unguentum Sulphuris Alkalinum.—20 parts of washed sulphur; 10 parts of carbonate of potassium; 5 parts of water, and 65 parts of benzoinated lard.

Sulphur loosely combined.

Acidum Hydrosulphuricum.—By acting on ferrous sulphide with diluted sulphuric acid. (See Tests.)
Carbonei Bisulphidum.—By passing sulphur vapor over red-hot charcoal.
Phosphorus.—Made by deoxidizing phosphoric acid with carbon.
Oleum Phosphoratum.—Made by dissolving 1 per cent. of phosphorus in almond oil.
Pilulæ Phosphori.—Each pill contains $\frac{1}{100}$ of a grain of phosphorus.

Unofficinal Compounds of Sulphur and Phosphorus.

Acidum Hyposulphurosum, H_2SO_2, = 66. Hyposulphurous Acid.	Add metallic zinc to sulphurous acid contained in a closed vessel.
Acidum Hypophosphorosum, H_3PO_2. Hypophosphorous Acid.	Decompose barium hypophosphite by the aid of sulphuric acid, filter, and evaporate to a syrupy consistence.
Acidum Metaphosphoricum, HPO_3. Metaphosphoric Acid.	Evaporate a solution of phosphoric acid until the residue ceases to give off water. This solidifies on cooling, and on exposure absorbs moisture and deliquesces.
Acidum Phosphorosum, H_3PO_3. Phosphorous Acid.	Expose phosphorus to moist air under a bell-jar, and collect the heavy white vapor which falls, in a vessel containing water.
Acidum Pyrophosphorosum, $H_4P_2O_7$. Pyrophosphorous Acid.	Precipitate sodium pyrophosphate with a solution of lead acetate, and decompose the well-washed lead pyrophosphate with hydrogen sulphide.

Sulphur. S; 32.

Sulphur is found uncombined in Sicily and in other parts of the world. In the form of sulphates and sulphides it is widely diffused. It is prepared for use by fusing it, allowing it to stand to permit the earthy impurities to settle, and then pouring it into cylindrical moulds. The sulphur in cylinders is termed *roll-sulphur*.

Three forms of sulphur are officinal,—sublimed, washed, and precipitated sulphur.

Sulphur forms with hydrogen an offensive gas, which is known officinally as hydrosulphuric acid, H_2S. It is also termed *sulphuretted hydrogen* and *hydrogen sulphide*. The formula for its preparation will be found under "Tests," in Part V. It is used for proving the presence or absence of certain metallic salts, lead, bismuth, antimony, copper, mercury, zinc, etc., with which it produces characteristic precipitates. *Sulphides* are compounds of elements with sulphur. Some of the sulphides are analogous to acids, others to bases; and these different sulphides, by combining with one another, form compounds, which, from their analogy to salts, are called by Berzelius *sulpho-salts*. It forms with oxygen two oxides, *sulphurous* oxide, SO_2, and *sulphuric* oxide, SO_3. These oxides, by their union with water, form *sulphurous acid*, H_2SO_3, and *sulphuric acid*, H_2SO_4. These are considered in the chapter on inorganic acids. There is also known *hyposulphurous acid*, H_2SO_2, the corresponding oxide of which is not known, and *thiosulphuric acid* (frequently known as hyposulphurous acid), $H_2S_2O_3$, and a series of acids, $H_2S_2O_6$, $H_2S_3O_6$, $H_2S_4O_6$, and $H_2S_5O_6$, known as the *thionic series*. Sulphurous acid forms with bases salts which are termed *sulphites*. The salts similarly produced from sulphuric acid are termed *sulphates*. The sulphates are much more important salts. Pharmaceutically, they have totally different properties. The officinal sulphites and sulphates will be considered under their respective bases.

Tests for Sulphites and Sulphurous Acid.

1. Solution of barium chloride produces with sulphurous acid or a solution of a sulphite, a white precipitate of barium sulphite, which is soluble in hydrochloric acid.
2. If a solution of a sulphite or sulphurous acid be added to diluted sulphuric acid and zinc, hydrosulphuric acid gas is liberated.
3. An acid solution of potassium permanganate is decolorized and deoxidized by sulphurous acid.

Tests for Sulphates and Sulphuric Acid.

1. A solution of barium chloride produces a white insoluble precipitate of barium sulphate with sulphuric acid or a soluble sulphate.
2. A soluble salt of lead produces a white insoluble precipitate of lead sulphate with sulphuric acid or a soluble sulphate.

SULPHUR SUBLIMATUM. *U. S.* Sublimed Sulphur.

S; 32.

Preparation.—When vapors of sulphur are conducted into a chamber properly cooled, they are condensed in the form of a crystalline powder, which collects on the sides and bottom of the chamber. The yellowish powder is known as sublimed sulphur, or *flowers of sulphur*. It is in the form of a fine, citron-yellow powder, of a slight, characteristic odor, and generally of a faintly acid taste, and an acid reaction. It

is insoluble in water or alcohol. When ignited, it burns with a blue flame, forming sulphurous acid gas, and leaving no residue or only a trace.

Uses.—Sublimed sulphur is given internally as a laxative and diaphoretic, in doses of from one to three drachms. It is often combined with bitartrate of potassium and administered to children mixed with honey or molasses. In diphtheritic croup it is sometimes used to remove the exudation by insufflation; externally, it is used as an ointment in scabies and other skin diseases. (See Unguentum Sulphuris.)

SULPHUR LOTUM. *U. S.* Washed Sulphur.

S; 32.

	By measure.
Sublimed Sulphur, 12 parts, or	16 oz. av.
Water of Ammonia, 1 part, or	10 fl. dr.
Water, a sufficient quantity.	

Add the Sulphur to *twelve parts* [or 1 pint] of Water previously mixed with the Water of Ammonia, and digest for three days, agitating occasionally. Then add *twelve parts* [or 1 pint] of Water, transfer the mixture to a muslin strainer, and wash the Sulphur with Water, until the liquid running from the strainer ceases to produce a precipitate in test-solution of chloride of barium. Then allow it to drain, press the residue strongly, dry it at a very gentle heat, and pass it through a No. 30 sieve.

Sublimed Sulphur is frequently contaminated with small quantities of sulphuric acid and other impurities, and the object of the ammonia in the above process is to neutralize the acid, the ammonium sulphate being subsequently washed out.

Sulphur Lotum. *U. S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A fine, citron-yellow powder. When heated to 115° C. (239° F.), Washed Sulphur melts, and at a higher temperature it is volatilized, without leaving more than a trace of residue.	Odorless; almost tasteless.	Insoluble.	Insoluble.	Completely soluble in a boiling solution of soda or in disulphide of carbon.

Impurities.	Tests for Impurities.
Free Acid.	Water agitated with it should not redden blue litmus paper.
Arsenious Sulphide.	If Washed Sulphur be digested with 2 parts of water of ammonia and the mixture filtered, the filtrate, on being supersaturated with hydrochloric acid, should remain unaltered.
Arsenious Acid.	If Washed Sulphur be digested with 2 parts of water of ammonia and the mixture filtered, no precipitate should be produced on passing hydrosulphuric acid through the filtrate.

Uses.—Washed sulphur is preferred to sublimed sulphur for internal administration; the small quantity of sulphuric acid present in the latter sometimes produces griping. The dose is from one to three drachms. It is used in the preparation of Compound Liquorice Powder, Iodide of Sulphur, and Alkaline Sulphur Ointment. (See Pulveres and Unguenta.)

SULPHUR PRÆCIPITATUM. *U.S.* **Precipitated Sulphur.**

S; 32.

Sublimed Sulphur, 100 parts, or	**16 oz. av.**
Lime, 50 parts, or	**8 oz. av.**
Hydrochloric Acid,	
Water, each, a sufficient quantity.	

Slake the Lime, and make it into a uniform mixture with *five hundred parts* [or 5 pints] of Water. Add the Sulphur, previously well dried and sifted, mix well, add *one thousand parts* [or 10 pints] of Water, and heat the mixture to boiling, over a fire, for one hour, stirring constantly, and replacing the Water lost by evaporation. Then cover the vessel, allow the contents to cool, pour off the clear solution, filter the remainder, and to the united liquids add, gradually, Hydrochloric Acid, previously diluted with an equal volume of Water, until the liquid is nearly neutralized, still retaining, however, an alkaline reaction. Collect the precipitate on a strainer, and wash it with Water until the washings are tasteless. Then dry it with a gentle heat.

In the above process the lime and sulphur react so as to form calcium disulphide and calcium thiosulphate (hyposulphite).

$$\underset{\text{Calcium Oxide.}}{3CaO} + \underset{\text{Sulphur.}}{6S} = \underset{\text{Calcium Disulphide.}}{2CaS_2} + \underset{\text{Calcium Thiosulphate.}}{CaS_2O_3}.$$

On the addition of hydrochloric acid, the sulphur is precipitated.

$$\underset{\text{Calcium Disulphide.}}{2CaS_2} + \underset{\text{Calcium Thiosulphate.}}{CaS_2O_3} + \underset{\text{Hydrochloric Acid.}}{6HCl} = \underset{\text{Calcium Chloride.}}{3CaCl_2} + \underset{\text{Sulphur.}}{6S} + \underset{\text{Water.}}{3H_2O}.$$

In some processes sulphuric acid is used instead of hydrochloric acid, and calcium sulphate is precipitated with the sulphur. This furnishes an inferior product, and is called *lac sulphuris*, or *milk of sulphur*.

Sulphur Præcipitatum. *U.S.*	**Odor and Taste.**	**Solubility.**		
		Water.	**Alcohol.**	**Other Solvents.**
A very fine, yellowish-white, amorphous powder. By heat it is completely volatilized.	Odorless; almost tasteless.	Insoluble.	Insoluble.	Completely soluble in a boiling solution of soda or in disulphide of carbon.

Impurities.	**Tests for Impurities.**
Free Acid.	Water agitated with it should not redden blue litmus paper.
Sulphate of Calcium.	If Precipitated Sulphur be boiled with diluted hydrochloric acid, the liquid filtered, and the filtrate divided into two portions, one portion should not be precipitated by test-solution of chloride of barium, and the other portion should not be rendered more than slightly turbid by test-solution of carbonate of ammonium with excess of water of ammonia.
Alkalies, Alkaline Earths, or Sulphide.	When Precipitated Sulphur is digested successively with water, hydrochloric acid, and water of ammonia, these liquids, after filtration, should leave no residue on evaporation.
Arsenious Sulphide.	If Precipitated Sulphur be digested with twice its weight of water of ammonia and the mixture filtered, the filtrate, after being supersaturated with hydrochloric acid, should remain unaltered.
Arsenious Acid.	If Precipitated Sulphur be digested with twice its weight of water of ammonia, and the mixture filtered, no precipitate should be formed on passing hydrosulphuric acid through the filtrate.

Uses.—Precipitated sulphur is much to be preferred to the other forms in liquid mixtures, as the particles are lighter and more easily suspended; the ointments made with it are smoother than those made with sublimed sulphur. The dose is from one to three drachms.

SULPHURIS IODIDUM. *U. S.* Iodide of Sulphur.

	By measure.
Washed Sulphur, 1 part, or	60 grains.
Iodine, 4 parts, or	240 grains.
	300 grains.

Rub them together until they are thoroughly mixed. Introduce the mixture into a flask, close the orifice loosely, and apply a gentle heat so as to darken the mass without melting it. When the color has become uniformly dark throughout, increase the heat so as to produce liquefaction, and incline the flask in different directions, in order to return into the liquid any portion of Iodine which may have been condensed on the inner surface of the flask. Then withdraw the heat, and, after the liquid has become solid, break the flask, reduce the fused mass to pieces, and keep them in a glass-stoppered bottle.

This compound is one of the instances of the direct chemical union of two elements, heat being the only agent used to effect the combination: it is sometimes called *subiodide of sulphur*, or *iodine disulphide*, S_2I_2. There are some doubts, however, as to its being a definite chemical compound.

Sulphuris Iodidum. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A grayish-black solid, generally in pieces having a radiated, crystalline appearance. When exposed to the air, it gradually loses iodine. On being heated, it sublimes, the first part of the sublimate consisting of iodine, and the subsequent portion containing both iodine and sulphur. On continued heating it is volatilized, without leaving more than a trace of residue.	Characteristic odor of iodine; somewhat acrid taste; faintly acid reaction.	Insoluble.	Alcohol dissolves out the iodine and leaves the sulphur.	Very soluble in disulphide of carbon; also in 60 parts of glycerin. Ether dissolves out the iodine and leaves the sulphur.

Test.

If 100 parts of Iodide of Sulphur be thoroughly boiled with water, all the Iodine will escape, and about 20 parts of sulphur will remain.

Uses.—Iodide of sulphur is principally used externally in skin diseases in the form of an ointment.

CARBONEI BISULPHIDUM. *U.S.* **Bisulphide of Carbon. [Disulphide of Carbon.]**

CS_2; 76.

This sulphide is prepared by the direct combination of carbon and sulphur at a moderate red heat. To effect this, charcoal is heated to redness in a vertical cylinder, while sulphur is admitted through a lateral tubulure near the bottom. As the sulphur melts and vaporizes, it combines with the carbon, and the carbon disulphide formed distils over through a series of condensing tubes, which, while they serve to collect the crude carbon disulphide, allow of the escape of the hydrogen sulphide formed at the same time.

It is purified by agitation with mercury, and distillation in contact with white wax. It can by repeated rectification be entirely freed from its usual disgusting odor.

Bisulphide of Carbon should be kept in well-stopped bottles, in a cool place, remote from lights or fire.

Carbonei Bisulphidum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A clear, colorless, very diffusive, highly refractive liquid. Sp. gr. 1.272.	Strong characteristic odor; sharp, aromatic taste; neutral.	Insoluble.	Soluble.	Soluble in ether, chloroform, and fixed or volatile oils.

Tests for Identity.	Impurities.	Tests for Impurities.
It vaporizes abundantly at ordinary temperatures, is highly inflammable, boils at 46° C. (114.8° F.), and, when ignited, burns with a blue flame, producing carbonic and sulphurous acids.	Sulphurous Acid.	Bisulphide of carbon should not affect the color of blue litmus paper moistened with water.
	Sulphur.	A portion of the liquid evaporated spontaneously in a glass vessel should leave no residue.
	Hydrosulphuric Acid.	Test-solution of acetate of lead agitated with the liquid should not be blackened.

Uses.—Bisulphide of carbon is used principally as a solvent. It is the best solvent for rubber and similar bodies. It is poisonous when taken internally, and the continuous inhalation of its vapor is very injurious.

Phosphorus. P; 31.

Preparation.—Phosphorus is a non-metallic element prepared by heating acid calcium phosphate with charcoal. The acid calcium phosphate is obtained by treating calcium phosphate with sulphuric acid, calcium sulphate also being formed; the latter is afterwards separated.

$$\underset{\text{Calcium Phosphate.}}{Ca_3(PO_4)_2} + \underset{\text{Sulphuric Acid.}}{2H_2SO_4} = \underset{\text{Acid Calcium Phosphate.}}{CaH_4(PO_4)_2} + \underset{\text{Calcium Sulphate.}}{2CaSO_4}.$$

Of the allotropic forms of phosphorus, *red phosphorus*, or *amorphous phosphorus*, is the most important. It is obtained by allowing phosphorus to remain for several days in an atmosphere of carbon dioxide at a temperature varying from 215° C. (419° F.) to 250° C. (482° F.)

Red phosphorus is not luminous and not poisonous until it is heated to 280° C. (536° F.), when it is converted into ordinary phosphorus.

Phosphorus forms with oxygen three oxides,—*phosphoric*, P_2O_5, *phosphorous*, P_2O_3, and *hypophosphorous*, P_2O, although the existence of the latter is somewhat doubtful. Corresponding to the first of these are three acids, known as *orthophosphoric* (tribasic phosphoric), H_3PO_4, *pyrophosphoric*, $H_4P_2O_7$, and *metaphosphoric*, HPO_3. Orthophosphoric acid is formed by dissolving P_2O_5 in boiling water, or by the action of nitric acid upon phosphorus itself; pyrophosphoric acid, by the heating of the tribasic phosphoric acid to 213° C. (415.4° F.); and metaphosphoric acid, by the ignition of the tribasic variety, or by dissolving P_2O_5 in cold water. *Phosphorous acid*, H_3PO_3, cannot be formed directly from phosphorous oxide. This is a dibasic acid, containing one hydrogen atom not replaceable by metal. *Hypophosphorous acid*, H_3PO_2, is not capable of being derived directly from hypophosphorous oxide. It is monobasic, containing two hydrogen atoms not replaceable by metal.

Tests for Phosphates and Phosphoric Acids.

1. Solution of silver nitrate produces a yellow precipitate with a neutral solution of an orthophosphate, soluble both in nitric acid and in ammonia. It produces a white precipitate with pyrophosphoric acid or metaphosphoric acid.

2. If albumen be added to metaphosphoric acid, or to a solution of a metaphosphate containing acetic acid, a white precipitate is produced. No precipitate occurs if it be added to pyrophosphoric acid or orthophosphoric acid.

3. Officinal test-solution of magnesium (see Tests) produces with phosphoric acid or a solution of a phosphate a precipitate of ammoniomagnesium phosphate.

4. If solution of ammonium molybdate in diluted nitric acid be added in excess to phosphoric acid or to a solution of a phosphate in nitric acid, and heat applied, a yellow precipitate of ammonium phosphomolybdate will be produced.

5. If a solution of barium chloride be added to a neutral solution of a phosphate, a white precipitate of barium phosphate is produced, which is soluble in acids.

Tests for Hypophosphites.

1. When heated, they evolve spontaneously inflammable phosphoretted hydrogen.

2. An acid solution of potassium permanganate is decolorized.

3. From solution of mercuric chloride, mercury is precipitated upon the addition of a solution of a hypophosphite.

Phosphorus. *U.S.*	Odor and Taste.	Solubility.	
		Water.	Other Solvents.
A translucent, nearly colorless solid, of a waxy lustre, having, at the ordinary temperature, about the consistence of beeswax. It melts at 44° C. (111.2° F.). Sp. gr. 1.830 at 10° C. (50° F.).	Distinctive and disagreeable odor; distinctive and disagreeable taste.	Insoluble.	Soluble in 350 parts of absolute alcohol, in 240 parts of boiling absolute alcohol, in 80 parts of absolute ether, in about 50 parts of any fatty oil, and very abundantly soluble in disulphide of carbon, the latter yielding a solution which must be handled with the greatest care to prevent danger from fire.

Tests for Identity.	Impurities.	Tests for Impurities.
When exposed to the air, it emits white fumes, which are luminous in the dark, and have an odor somewhat resembling that of garlic. On longer exposure to air, it takes fire spontaneously.	Arsenic.	If 3 Gm. of Phosphorus are digested with 24 Gm. of nitric acid and 18 Gm. of distilled water until it is completely dissolved, the solution evaporated until no more nitrous vapors are given off, then diluted with distilled water, so as to weigh about 36 Gm., and hydrosulphuric acid gas be passed through the larger portion of the liquid, heated for half an hour to about 70° C. (158° F.) and afterward until the liquid cools, there should not appear more than a trifling quantity of a lemon-yellow precipitate after the lapse of twenty-four hours.
	Sulphur.	On adding test-solution of chloride of barium to the remainder of the above liquid, not more than a slight opalescence should make its appearance.

Uses.—Phosphorus is administered internally, in doses of $\frac{1}{100}$ of a grain. As a nervous stimulant, in large doses it is poisonous. Its value in this connection depends upon its being administered in a free state. The oxide of phosphorus, phosphoric acid, does not have the same action: hence all pharmaceutical preparations of phosphorus must be protected from oxidation. (See Pilulæ Phosphori.)

OLEUM PHOSPHORATUM. *U.S.* Phosphorated Oil.

	By measure.
Phosphorus, 1 part, or	4 grains.
Stronger Ether, 9 parts, or	1 fl. dr.
Expressed Oil of Almond, a sufficient quantity.	
To make 100 parts, or	1 fl. oz.

Introduce *a sufficient quantity* of Expressed Oil of Almond into a flask, heat it, on a sand-bath, to 250° C. (482° F.), and keep it at that temperature for fifteen minutes. Then allow it to cool, and filter it. Put *ninety parts* [or 7 fl. dr.] of the filtered Oil, together with the Phosphorus, previously well dried by blotting-paper, into a dry bottle capable of holding somewhat more than *one hundred parts* [or 1 fl. oz.], insert the stopper and heat the bottle in a water-bath until the Phosphorus melts, agitate it until the Phosphorus is dissolved, allow it to cool, and add the Ether. Lastly, transfer the solution to small, glass-stoppered vials, which should be completely filled, and kept in a cool and dark place.

The object of this preparation is to administer phosphorus in minute doses, dissolved in a bland oil. When fresh, it is a clear and colorless or but slightly colored oil, phosphorescent in the dark, and having the odor and taste of phosphorus quite distinctly. The object of heating the oil is to expel air and traces of water, which would aid in oxidizing the phosphorus. The ether not only assists in the preservation of the finished preparation, but is of use in rendering the oil less disagreeable to the taste. It may be administered in the form of an emulsion, preferably the officinal almond emulsion, and flavored with oil of bitter almond, or in capsules: each minim contains about $\frac{1}{115}$ of a grain of phosphorus. The dose of the U. S. solution is from three to five minims.

CHAPTER XXXVI.

CARBON, BORON, AND SILICON.

C; 12. B; 11. Si; 28.

THESE three elements present some analogies, and, although the number of pharmaceutical preparations made from them is not great, they are of considerable interest.

Officinal Preparations of Carbon, Boron, and Silicon.

Carbo Animalis.—Prepared by burning bones out of contact with air.
Carbo Animalis Purificatus.—Made by purifying animal charcoal with HCl
Carbo Ligni.—Made by burning wood out of contact with air.
Carbonei Bisulphidum.—See preparations of sulphur.
Acidum Boricum.—Made by purifying the natural product.
Sodii Boras.—See preparations of soda.
Liquor Sodii Silicatis.—Made by fusing silica with dried sodium carbonate and dissolving the product.

Carbon. C; 12.

Carbon is a very widely diffused element. It is a constituent of all organic substances, and is found in nature in the form of the diamond, graphite, plumbago, coal, etc.

Two compounds with oxygen are known,—carbon dioxide, CO_2, and carbon monoxide, CO.

Carbon dioxide, CO_2, is a colorless, odorless gas, with a slightly acid taste, heavier than ordinary air. It is not combustible, and not a supporter of combustion; indeed, it is used extensively in fire-extinguishers and other contrivances to extinguish flame. Water is capable of absorbing its own volume of carbon dioxide, but many times its volume under pressure. This solution was formerly officinal, under the name of *Aqua Acidi Carbonici*, or carbonic acid water, the well-known "*soda water*."

Carbonic acid, H_2CO_3, is produced when carbon dioxide is brought in contact with water.

$$\underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O} = \underset{\text{Carbonic Acid.}}{H_2CO_3}.$$

The salts known as carbonates are widely diffused in nature, and many chemical processes are based upon the decomposition of carbonates by strong acids. Carbonic acid, although present everywhere, is one of the weakest acids known.

Carbon monoxide, CO, is of little interest in pharmacy.

The compounds of carbon and hydrogen are very numerous, and of great importance. They are mostly obtained from organic substances, and will be considered under Part IV. With nitrogen, carbon forms cyanogen, the compound radical of hydrocyanic or prussic acid.

Tests for Carbonates.

1. Decompose by the addition of a strong acid, and pass the gas through lime-water. Insoluble calcium carbonate is formed.
2. The solutions of many of the salts of the metals, like iron, copper, lead, etc., are precipitated by the soluble carbonates.

CARBO ANIMALIS. *U. S.* Animal Charcoal.

C; 12.

Preparation.—Animal charcoal is made by subjecting bones to a red heat in close vessels.

Bone consists of animal matter with calcium phosphate and carbonate. In consequence of the decomposition of the animal matter involved by the destructive distillation, the nitrogen and hydrogen, united as ammonia, distil over, while the greater part of the carbon is left in the cylinder, intermingled with the calcium salts.

The charcoal is termed *bone-black* or *ivory-black*, and in manufacturing it the bones are boiled in water, to separate the fat, before being subjected to destructive distillation in the iron cylinders. These are connected with vessels which receive the ammoniacal liquor, called *bone-spirit*, together with a dark tarry liquid (*bone-oil*).

Officinal animal charcoal is in dull-black, granular fragments, or a dull-black powder, odorless and nearly tasteless, and insoluble in water or in alcohol. When ignited, it leaves a white ash, amounting to at least 86 per cent. of the original weight, which should be completely soluble in hydrochloric acid, with the aid of heat.

Uses.—Animal charcoal is used to deprive substances of color (see Decoloration, page 198).

CARBO ANIMALIS PURIFICATUS. *U. S.* Purified Animal Charcoal.

	By measure.
Animal Charcoal, in No. 60 powder, 2 parts, or	16 oz. av.
Hydrochloric Acid, 3 parts, or	20 fl. oz.
Water, a sufficient quantity.	

Pour the Hydrochloric Acid, previously mixed with *fifteen parts* [or 7½ pints] of Water, upon the Animal Charcoal, and digest the mixture on a water-bath for twenty-four hours, occasionally stirring. Pour off the supernatant liquid, and digest the undissolved portion with *fifteen parts* [or 7½ pints] of Water for two hours. Transfer the mixture to a strainer, and, when the liquid portion has run off, wash the residue with Water until the washings cease to be affected by test-solution of nitrate of silver. Dry the product, heat it to dull redness in a closely-covered crucible, and, when cool, keep it in well-stopped bottles.

The object of purifying animal charcoal by treatment with hydrochloric acid is to separate the calcium phosphate and carbonate which

are invariably present in the crude bone-black. In some decolorizing operations these impurities are harmless, but in many delicate chemical processes they may be dissolved or decomposed, and thus seriously contaminate the products which the charcoal is intended to purify.

Officinal purified animal charcoal is a dull-black powder, odorless and tasteless, and insoluble in water, alcohol, or other solvents. When ignited at a high temperature with a little red oxide of mercury and with free access of air, it leaves at most only a trace of residue. If 1 part be digested with 2 parts of hydrochloric acid and 6 parts of water, the filtrate, after being supersaturated with water of ammonia, should remain unaffected by test-solution of magnesium.

CARBO LIGNI. *U. S.* Charcoal.

Preparation.—Charcoal prepared from soft wood is preferred for medical purposes. It is made by burning wood out of contact with air, either in iron cylinders or in stacks. In the former case, the volatile products resulting from the destructive distillation are collected by condensation, and contribute valuable products to pharmacy (see Acidum Aceticum). In the latter, the charcoal is made in the neighborhood of a cheap wood-supply. Billets of wood are piled in a conical form, and covered with earth and sod to prevent the free access of air, several holes being left at the bottom and one at the top of the pile in order to produce a draught to commence the combustion. The wood is kindled from the bottom, and soon after ignition the hole at the top is closed, and when the wood is all ignited the holes at the bottom are stopped. The result is that the volatile portions of the wood, hydrogen, oxygen, water, etc., are dissipated, carbon being left.

Uses.—Charcoal is used in medicine as an absorbent and disinfectant. It is given in the form of powder, in doses of one to two drachms. Owing to its absorbent powers, it should never be kept exposed to the air, as it will become unfit for use if subjected to the atmosphere of a laboratory or pharmacy. Tin cans with tightly-fitting covers are appropriate containers.

Boron. B; 11.

Boron, like carbon, exists in three allotropic conditions,—amorphous, crystallized, and graphitoidal. Boron combines with hydrogen and oxygen, and boric (or boracic) acid is produced, H_3BO_3, the principal salt of which is Sodii Boras, or borax (see page 478).

Tests for Borates and Boric Acid.

1. A colorless flame is tinged green by an alcoholic solution of boric acid.

2. A solution of a borate, if slightly acidified by hydrochloric acid, turns the yellow color of turmeric paper brown, if the paper is allowed to dry.

Unofficinal Preparations of Boron.

Acidum Metaboricum, HBO_2, = 44. Metaboric Acid.	By heating boric acid to 38° C. (100° F.).
Acidum Pyroboricum, $H_2B_4O_7$, = 125. Pyroboric Acid.	By heating boric acid for a long time to 60° C. (140° F.).
Boron Trisulphidum, B_2S_3, = 118. Trisulphide of Boron.	By heating boron in the vapor of sulphur and collecting the resulting white mass.

ACIDUM BORICUM. *U.S.* Boric Acid (Boracic Acid).

H_3BO_3; 62.

Preparation.—The lagoons of the volcanic districts of Tuscany formerly furnished the greater part of the boric acid and borax of commerce. Borax is now found native in California, and boric acid is produced by decomposing borax with hydrochloric acid.

$$\underset{\text{Sodium Borate.}}{Na_2B_4O_7 10H_2O} + \underset{\text{Hydrochloric Acid.}}{2HCl} = \underset{\text{Sodium Chloride.}}{2NaCl} + \underset{\text{Boric Acid.}}{4H_3BO_3} + \underset{\text{Water.}}{5H_2O}.$$

Boric acid is required in very fine powder for most medical uses.

Acidum Boricum. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Transparent, colorless, six-sided plates, slightly unctuous to the touch, permanent in the air.	Odorless; cooling, bitterish; feebly acid in solution, turning blue litmus paper red, and turmeric paper brown; the tint in the latter case remaining unaltered in the presence of free hydrochloric acid.	Cold, 25 parts. Boiling, 3 parts.	Cold, 15 parts. Boiling, 5 parts.

Tests for Identity.	Impurities.	Tests for Impurities.
On ignition, the acid loses 43.5 per cent. of its weight, and on cooling becomes transparent and brittle. The alcoholic solution burns with a flame tinged with green.	Sulphate.	An aqueous solution of the acid should not be precipitated by test-solution of chloride of barium.
	Chloride.	Nitrate of silver with nitric acid.
	Lead, Copper, Iron, etc.	Sulphide of ammonium.
	Calcium.	Oxalate of ammonium.
	Sodium Salt.	A fragment heated on a clean platinum wire in a non-luminous flame should not impart a persistent yellow color.

Uses.—Boric acid is used in what is known as antiseptic surgery, and externally in the form of an ointment. It is added in small quantities to various liquids, to prevent fermentation. It is well adapted for such uses, as it communicates but little taste. It has not been proved to be innocuous, however, and therefore should be sparingly used.

Silicon. Si; 28.

Very few of the compounds of the non-metallic element silicon are used medicinally. Silicon, like carbon and boron, is obtained in three allotropic states,—amorphous, crystalline, and graphitoidal. In some of its combinations, notably in glass, earthen-ware, china, mortar, and cements of various kinds, it is of vast importance commercially. Silicon is found in nature combined with aluminium, magnesium, or calcium, in pumice-stone, meerschaum, asbestos, etc.; or as an anhydride (silica), in sand, flint, agate, quartz, etc.

Silica, SiO_2, may be obtained in a pure condition by treating officinal solution of silicate of sodium with hydrochloric acid.

$$\underset{\text{Sodium Silicate.}}{Na_2SiO_3} + \underset{\text{Hydrochloric Acid.}}{2HCl} = \underset{\text{Silica.}}{SiO_2} + \underset{\text{Sodium Chloride.}}{2NaCl} + \underset{\text{Water.}}{H_2O}.$$

Test for Silicates.

Silicates are insoluble in most reagents. If the soluble sodium and potassium silicates, in aqueous solution, be neutralized with hydrochloric acid, and water of ammonia be added in excess, a gelatinous precipitate of silicic hydrate will separate.

LIQUOR SODII SILICATIS. *U. S.* Solution of Silicate of Sodium.

Preparation.—Sodium silicate (Na_2SiO_3), or *soluble glass*, is made by fusing one part of fine sand and two parts of dried sodium carbonate, mixed in powder, in an earthen-ware crucible, and pouring out the fused mass on a stone slab to cool. This is pulverized, and treated with boiling water, to dissolve the soluble part. The solution is filtered and concentrated: crystals may be formed upon evaporation, if desired.

The salt is used commercially entirely in solution. This usually contains about 20 per cent. of silica and 10 per cent. of soda.

Liquor Sodii Silicatis. *U. S.*	Odor, Taste, and Reaction.	Solubility.
A semi-transparent, almost colorless, or yellowish, or pale greenish-yellow, viscid liquid. Sp. gr. between 1.300 and 1.400.	Odorless; sharp, saline, and alkaline taste; alkaline reaction.	Miscible with boiling water, insoluble in alcohol.

Tests for Identity.	Impurities.	Test for Impurities.
A drop of the solution, when held in a non-luminous flame, imparts to it an intense yellow color. If a portion of the solution, considerably diluted with water, be supersaturated with nitric acid, a gelatinous or pulverulent, white precipitate of silicic hydrate will be produced.	Excessive amount of Alkali.	A small quantity should not produce any caustic effect when applied to the skin.

Uses.—This solution is used in surgery in preparing mechanical dressings.

CHAPTER XXXVII.

THE ALKALIES AND THEIR COMPOUNDS.

Potassium, Sodium, Lithium, and Ammonium.

K; 39. Na; 23. Li; 7. NH_4; 18.

THE alkalies are bodies having strongly-marked physical and chemical properties: 1. They combine with acids to form salts. 2. They restore the color of reddened litmus paper, and change the colors of vegetable blues to green, and of vegetable yellows to brown. 3. Their taste is never sour, but it is characteristic, and caustic if the alkali is in concentrated solution. The salts formed by their combinations with acids possess acid, alkaline, or neutral reactions according to the relative strength and proportion of the component parts.

The metals known as alkali-metals which form compounds of pharmaceutical interest are potassium, sodium, and lithium. They are all univalent, and of a white color resembling that of silver, and are so prone to oxidation that they must be kept constantly immersed in some carbo-hydrogen or body free from oxygen, like naphtha or petroleum. They are so soft that they can be easily cut with a penknife. They float upon water, and inflame spontaneously and immediately when brought in contact with it.

The alkali-metals are often called light metals, on account of their low specific gravity when compared with the others.

Their carbonates are all soluble in water, and each metal forms but one chloride.

Their oxides are strongly basic, restoring the color of reddened litmus quickly. The oxides are also very soluble in water, forming caustic and powerfully alkaline hydrates, which cannot be decomposed by heat.

Their sulphates, phosphates, nitrates, sulphides, chlorides, bromides, iodides, and nearly all their salts, are soluble in water, are almost without exception colorless, or of an opaque white color, and many of them, if heated to redness, fuse without decomposition.

The processes for obtaining the metals are very similar, and consist in exposing their carbonates, intimately mixed with finely-powdered charcoal, in suitable iron vessels, to an intense heat: carbon monoxide is liberated, and the vapors of the metals are condensed in flattened receivers.

Ammonium is a compound radical, NH_4, but has so many analogies with the alkali-metals that it is classed with them.

CHAPTER XXXVIII.

THE POTASSIUM SALTS.

THE salts of potassium are among the most important of any that are used in medicine. They are generally very soluble, and, with a few exceptions, are colorless or of an opaque white color. The sole source of the potassium salts was formerly wood-ashes, but at present cheaper sources have been discovered. The wood-ashes were lixiviated, the liquid containing the soluble salts evaporated to dryness, and the residue allowed to cool. This constituted the crude *potash* of commerce.

Potash is now made from the ashes from beet-sugar residues, from *suint*, the residue obtained by evaporating the water used to scour the fleeces of sheep, and from an impure chloride of potassium obtained from the Stassfurt mines in Germany, which is now the principal source of the potassium compounds.

The salts are converted into potassium sulphate, and this into carbonate by heating with coal and limestone. For the purpose of converting the sulphate into the carbonate, it is heated in a reverberatory furnace with the proper quantity of coal and limestone, with the coal in order to form potassium sulphide, and with the limestone to convert the sulphide into carbonate, the sulphur uniting with the calcium to form calcium sulphide. The mass, after cooling, is lixiviated with water, and this solution of impure potassium carbonate is filtered to separate the insoluble calcium sulphide, and subsequently treated with milk of lime, by which insoluble calcium carbonate is precipitated, and potassium hydrate in solution remains. The liquid is then evaporated to dryness.

Tests for Potassium Salts.

Potassium may be recognized in its combinations by the following tests:

1. The addition of platinic chloride with a little alcohol and a few drops of hydrochloric acid produces a yellow crystalline precipitate, $PtCl_4 2KCl$ (double chloride of platinum and potassium).
2. With an excess of a concentrated solution of tartaric acid, a white crystalline precipitate is slowly formed when a strong solution of a potassium salt is added with stirring. This is the well-known acid potassium tartrate (cream of tartar).
3. A colorless flame is tinted violet by pure potassium salts.
4. Potassium salts are soluble in water, and not volatile at a red heat.

Officinal Preparations of Potassium.

Officinal Name.	Preparation.
With Inorganic Radicals.	
Potassa	From the ashes of plants, etc., by lixiviating, concentrating the solutions, evaporating to dryness, purifying by treating a dilute solution with lime, evaporating, fusing, and casting into moulds.
Potassa cum Calce	By mixing equal parts of well-dried potassa and lime together.
Liquor Potassæ	About 5 per cent. solution of potassium hydrate made by dissolving the hydrate in water.
Potassa Sulphurata	By melting potassa and sulphur together in a crucible, pouring the liquid on a slab, and cooling.
Potassii Bicarbonas	By passing carbon dioxide into a solution of carbonate, evaporating and crystallizing.
Potassii Bichromas	By treating potassium chromate with sulphuric acid, evaporating and crystallizing.
Potassii Bromidum	By treating solution of potassa with bromine and charcoal.
Potassii Carbonas	By purifying pearl-ash by dissolving it in water, filtering, evaporating, and granulating.
Potassii Chloras	By reacting on potassium chloride with calcium hypochlorite.
Potassii Cyanidum	By fusing potassium ferrocyanide with potassium carbonate, separating the insoluble precipitate of metallic iron, and pouring the fused mass on a slab.
Potassii Ferrocyanidum	By heating nitrogenized substances with iron and potassa.
Potassi Hypophosphis	By precipitating calcium hypophosphite with potassium carbonate.
Potassii Iodidum	By treating solution of potassa with iodine, evaporating to dryness, and heating with charcoal.
Potassii Nitras	By decomposition of sodium nitrate with potassium chloride.
Potassii Permanganas	By heating together manganese dioxide, potassium chlorate, and potassa.
Potassii Sulphas	By purifying the residue from nitric acid manufacture, and from other sources.
Potassii Sulphis	By passing sulphurous acid gas through a solution of potassium carbonate.
Liquor Potassii Arsenitis	By boiling potassium bicarbonate with arsenious acid, and adding a small quantity of compound tincture of lavender.
Trochisci Potassii Chloratis	Each troche contains five grains of potassium chlorate, with spirit of lemon, sugar, tragacanth, and sufficient water to form a mass.
With Organic Radicals.	
Potassii Acetas	By decomposing potassium bicarbonate with acetic acid, and evaporating the filtered solution, carefully avoiding contact with iron.
Potassii Bitartras	By purifying argols, the sediment deposited in wine-casks during fermentation.
Potassii Citras	By decomposing potassium bicarbonate with citric acid, evaporating and granulating.
Potassii et Sodii Tartras	By treating solution of potassium bitartrate with sodium carbonate.
Potassii Tartras	By treating solution of potassium bitartrate with potassium carbonate.
Liquor Potassii Citratis	8 parts of potassium bicarbonate with 6 parts of citric acid in 100 parts of water.
Mistura Potassii Citratis	10 parts of potassium bicarbonate to 100 parts of lemon-juice.

Unofficinal Potassium Salts.

Names.	Preparation.
Potassii Antimonias, $KSbO_3$, = 207. Antimoniate of Potassium.	Deflagrating 1 p. metallic antimony with 4 p. potassium nitrate, and lixiviating with water.
Potassii Bisulphas, $KHSO_4$, = 272. Bisulphate of Potassium.	Residue remaining in retort on preparing nitric acid from potassium nitrate and sulphuric acid.
Potassii Bisulphis, $KHSO_3$, = 120. Bisulphite of Potassium.	Passing an excess of sulphurous acid gas into a concentrated solution of potassium carbonate.
Potassii Borotartras. Borotartrate of Potassium.	Dissolve by heat 4 p. potassium bitartrate, 1 p. boric acid in 10 p. water, and evaporate to dryness.
Potassii Chloridum, KCl, = 74.4. Chloride of Potassium.	Obtained as a by-product in many salts.
Potassii Chromas, K_2CrO_4, = 194.4. Chromate of Potassium.	Add potassium carbonate to a hot solution of bichromate until effervescence ceases.
Potassii et Ammonii Tartras, $KNH_4C_4H_4O_6$, = 205. Tartrate of Potassium and Ammonium.	Diffuse 1 p. potassium bitartrate in 3 p. boiling water; then add ammonium carbonate until effervescence ceases; filter and crystallize.
Potassii et Sodii Borotartras. Borotartrate of Potassium and Sodium.	Dissolve 2 p. sodium borate in 20 p. distilled water, and digest with 5 p. potassium bitartrate.
Potassii Ferricyanidum, $K_6Fe_2Cy_{12}$, = 658. Ferricyanide of Potassium.	Pass chlorine gas into a cold solution of potassium ferrocyanide until it ceases to produce blue precipitate with ferric chloride.
Potassii Iodas, KIO_3, = 214. Iodate of Potassium.	Pass chlorine gas into cold water containing iodine in suspension until wholly dissolved; then add potassium chlorate and warm.
Potassii Iodohydrargyras, $(2KI.HgI_2)3H_2O$, = 1290.7. Iodohydrargyrate of Potassium.	Dissolve 3 p. mercuric iodide in a concentrated solution of potassium iodide containing 2 p. of the salt; when cool, yellow prisms will deposit from the mother-liquid.
Potassii Nitris, KNO_2, = 85. Nitrite of Potassium.	Made by heating the nitrate to redness and separating undecomposed nitrate; by dissolving the fused mass in water the nitrate will crystallize out; the mother-liquor is treated with diluted acetic acid and twice its volume of alcohol, to separate more nitrate. The nitrite may be obtained by evaporating the solution over sulphuric acid.
Potassii Perchloras, $KClO_4$, = 138.4. Perchlorate of Potassium.	Heat potassium chlorate until it melts; keep at this temperature until gas ceases to be evolved, and a portion tested with strong HCl acquires only a faint yellow color. Dissolve in water and recrystallize.
Potassii Platinocyanidum, $2KCN.Pt(CN)_2.3H_2O$, = 676.8. Platinocyanide of Potassium.	Mix concentrated solutions of 1 p. exsiccated platinic chloride and 2 p. potassium cyanide; heat the mixture until the precipitate is redissolved.
Potassii Pyrosulphis, $K_2(SO)_2O$, = 190. Pyrosulphite of Potassium.	Pass sulphurous acid gas into a warm, saturated solution of potassium carbonate; on cooling, it deposits crystals.
Potassii Salicylas, $(KC_7H_5O_3)_2.H_2O$, = 370. Salicylate of Potassium.	Dissolve 7 p. potassium bicarbonate in water; then add gradually 10 p. salicylic acid, and evaporate.
Potassii Silicas, K_2SiO_3, = 154. Silicate of Potassium.	Fuse 10 p. potassium carbonate, 15 p. fine sand, and 1 p. charcoal.
Potassii Sulphidum, K_2S, = 110. Sulphide of Potassium.	Pass sulphuretted hydrogen gas into a solution of potassa as long as it is absorbed, and add an equal bulk of potassa solution; evaporate.
Potassii Sulphocarbonas, K_2CS_3, = 186. Sulphocarbonate of Potassium.	Mix a solution of potassium sulphide with carbon disulphide; on evaporation, orange-yellow crystals are deposited.
Potassii Sulphocyanas, KSCN, = 97. Sulphocyanate of Potassium.	Melt together 17 p. potassium carbonate, 32 p. sulphur, and 46 p. anhydrous potassium ferrocyanide, and heat to low redness. When cool, treat with boiling alcohol.

POTASSA. *U.S.* Potassa.

KHO; 56.

Preparation.—Potassa, called commercially caustic potash, is made by evaporating a solution of potassium hydrate rapidly in a silver or

clean iron vessel until a fluid of oily consistence remains, a drop of which, when removed on a warm glass rod, solidifies on cooling. The hot caustic potassa is poured into cylindrical moulds, and while the sticks are still warm they are bottled quickly, to prevent deliquescence.

Pure caustic potassa is sometimes prepared in the form of powder by stirring the fused mass rapidly with a silver spatula until a granulated powder is formed. This must be placed in warm dry bottles and quickly sealed hermetically.

Potassa by Alcohol and *Potassa by Barytes* are terms used to designate pure caustic potassa made by purifying with alcohol and barium hydroxide, alcohol dissolving only the caustic potassa, whilst the sulphate is separated by treatment with baryta-water, forming the insoluble barium sulphate.

Potassa. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, hard and dry solid, generally in form of pencils, very deliquescent. When heated nearly to a red heat, it melts, forming an oily liquid. At a strong red heat it is slowly volatilized unchanged.	Odorless, or having a faint odor of lye; very acrid and caustic taste; strongly alkaline reaction.	Cold. 0.5 parts. Boiling. Very soluble.	Cold. 2 parts. Boiling. Very soluble.

Test for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
Its aqueous solution dropped into solution of tartaric acid produces a white, crystalline precipitate which is redissolved by an excess of solution of Potassa.	Organic Matter.	An aqueous solution of Potassa should be colorless.
	Chloride.	After being supersaturated with nitric acid, should not be more than slightly clouded on the addition of test-solution of nitrate of silver.
To neutralise 2.8 Gm. of Potassa should require not less than 45 C.c. of the volumetric solution of oxalic acid (corresponding to at least 90 per cent. of absolute hydrate of potassium).	Sulphate.	After supersaturating a solution of Potassa with nitric acid, it should not be more than slightly clouded on the addition of test-solution of chloride of barium.
	Carbonate.	A solution of Potassa dropped into an acid should not produce more than a faint effervescence of isolated bubbles.
	Silica.	If 1 part of Potassa be dissolved in 2 parts of water, and the solution dropped into 4 parts of alcohol, not more than a slight precipitate should be separated.
	Carbonate.	If 1 part of Potassa be dissolved in 2 parts of water, and the solution dropped into 4 parts of alcohol, not more than a small amount of a dense aqueous layer should be separated.

Uses.—Potassa is used as a caustic, principally, however, in veterinary practice: the end of the stick may be wrapped several times with tin-foil, to avoid cauterizing the finger of the operator. When this form of potassium hydrate is used for making officinal solution of potassa, care should be taken to allow for the moisture contained in it: commercial caustic potassa rarely contains less than 30 per cent. of water.

POTASSA CUM CALCE. *U. S.* Potassa with Lime.

Potassa, 50 parts, or	1 oz. av.
Lime, 50 parts, or	1 oz. av.
To make 100 parts, or	2 oz. av.

Rub them together so as to form a powder, and keep it in a well-stopped bottle.

This preparation is a grayish-white powder, deliquescent, having a strongly alkaline reaction, and responding to the tests for Calx and Potassa. It should be soluble in hydrochloric acid without leaving more than a small residue. It should not effervesce on the addition of an acid. It is found in commerce moulded into sticks, which are often more convenient than the powdered form, because less deliquescent.

Uses.—Potassa with lime is used medicinally for the same purposes as caustic potassa: it is slower in its operation and more manageable than the latter.

LIQUOR POTASSÆ. *U. S.* Solution of Potassa.

An aqueous solution of Hydrate of Potassium [KHO; 56], containing about 5 per cent. of the hydrate.

	By measure.
Bicarbonate of Potassium, 90 parts, or	2½ oz. av.
Lime, 40 parts, or	1 oz. av.
Distilled Water, a sufficient quantity,	
To make 1000 parts, or	1½ pints.

Dissolve the Bicarbonate of Potassium in *four hundred parts* [or 10 fl. oz.] of Distilled Water, heat the solution until effervescence ceases, and then raise it to boiling. Slake the Lime, make it into a smooth mixture with *four hundred parts* [or 10 fl. oz.] of Distilled Water, and heat it to boiling. Then gradually add the first liquid to the second, and continue the boiling for ten minutes. Remove the heat, cover the vessel tightly, and, when the contents are cold, add enough Distilled Water to make the whole mixture weigh *one thousand parts* [or measure 1¼ pints]. Lastly, strain it through linen, set the liquid aside until it is clear, and remove the clear solution by means of a syphon.

Alternative Process.

	By measure.
Potassa, 56 parts, or	1 oz. av.
Distilled Water, 944 parts, or	1 pint.
To make 1000 parts, or about	1 pint.

Dissolve the Potassa in the Distilled Water. The Potassa used in this process should be of the full strength directed by the Pharmacopœia (90 per cent.). Potassa of any other strength, however, may be used, if a proportionately larger or smaller quantity be taken, the proper amount for the above formula being ascertained by dividing 5000 by the percentage of absolute Potassa (hydrate of potassium) con-

tained therein. Solution of Potassa should be kept in well-stopped bottles.

The potassium hydrate is obtained in the first formula by decomposing potassium bicarbonate through the action of calcium hydrate and heat. The direction to heat the solution of potassium bicarbonate until effervescence ceases is for the purpose of driving off as much of the carbonic acid as possible by the simplest method: the remainder is disposed of through double decomposition, as shown by the equation

$$\underset{\text{Potassium Carbonate.}}{K_2CO_3} + \underset{\text{Calcium Hydrate.}}{Ca(HO)_2} = \underset{\text{Potassium Hydrate.}}{2KHO} + \underset{\text{Calcium Carbonate.}}{CaCO_3}.$$

Preference is given to the bicarbonate as the source of the potassium, because the cheaper carbonates nearly always contain silicates and other impurities in sufficient quantities to render the product inferior.

The proportion of water is not a matter of indifference. The quantity used should be at least five times as great as that of the bicarbonate, and the lime must greatly exceed the amount indicated by theory. The sparing solubility of the lime sufficiently accounts for this.

It is advisable to strain the solution as rapidly as possible, merely to separate the bulk of the lime, and set it aside in tightly-covered jars until all sediment has deposited, and then decant the clear solution. This plan avoids the injurious contact of the air, by which carbonic acid is absorbed.

In the alternative formula ready-made potassa is used by simply dissolving it in water, the only advantages being those of greater convenience and the saving of labor and time.

Liquor Potassæ. *U.S.*	Odor, Taste, and Reaction.	Solubility.
A clear, colorless liquid. When dropped into a concentrated solution of tartaric acid, a white, crystalline precipitate, soluble in an excess of potassa, is produced (difference from solution of soda). Sp. gr. about 1.036.	Odorless; very acrid and caustic taste; strongly alkaline reaction.	Miscible in all proportions with water and alcohol.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
A drop taken up by a platinum loop and held in a non-luminous flame imparts to it a violet tint. To neutralize 28 Gm. of Solution of Potassa should require 25 C.c. of the volumetric solution of oxalic acid.	Carbonate.	When dropped into an acid, it should produce no effervescence, or, at most, only an escape of isolated bubbles.
	Alkaline Earths.	When neutralized by nitric acid, the Solution should not yield more than a faint cloudiness with test-solution of carbonate of sodium.
	Sulphate.	When neutralized by nitric acid, the Solution should not yield more than a faint cloudiness with test-solution of chloride of barium.
	Chloride.	When neutralized by nitric acid, the Solution should not yield more than a faint cloudiness with test-solution of nitrate of silver with a little nitric acid.
	Foreign Impurities.	The neutralized Solution, when evaporated to dryness, should yield a residue which should dissolve in water without leaving more than a small quantity of insoluble matter.

Uses.—Solution of potassa is a valuable antacid when given in doses of twenty minims, diluted with milk. If a large quantity should be swallowed accidentally, the proper antidotes would be mild acid liquids, like vinegar or lemon-juice, accompanied with bland oils.

POTASSA SULPHURATA. *U. S.* **Sulphurated Potassa.**

Sublimed Sulphur, 1 part, or	1 oz. av.
Carbonate of Potassium, 2 parts, or	2 oz. av.
	3 oz. av.

Rub the Carbonate of Potassium, previously dried, with the Sulphur, and heat the mixture gradually, in a covered crucible, until it ceases to swell and is completely melted. Then pour the liquid on a marble slab, and, when it has solidified and become cold, break it into pieces, and keep them in a well-stopped bottle of hard glass.

This preparation is not a definite chemical compound, as shown by its vague officinal name and the absence of a chemical formula. It is sometimes called *liver of sulphur*, and is a mixture of potassium hyposulphite and potassium sulphide, with probably some potassium pentasulphide and traces of undecomposed potassium carbonate. The effervescence is caused by the escape of carbonic acid gas.

$$\underset{\text{Potassium Carbonate.}}{3K_2CO_3} + \underset{\text{Sulphur.}}{4S_2} = \underset{\text{Potassium Sulphide.}}{2K_2S_3} + \underset{\text{Potassium Hyposulphite.}}{K_2S_2O_3} + \underset{\text{Carbon Dioxide.}}{3CO_2}.$$

This preparation should be *made by the pharmacist* in small quantities and dispensed in a fresh condition, as it is impossible to prevent deterioration. Potassium sulphide, which is its principal medicinal constituent, is converted, through oxidation, into inert potassium sulphate.

Potassa Sulphurata. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Irregular pieces of a liver-brown color when freshly prepared, turning gradually to greenish-yellow or brownish-yellow. The aqueous solution has an orange-yellow color and exhales the odor of hydrosulphuric acid. The latter is abundantly evolved on the addition of hydrochloric acid, while at the same time sulphur is deposited.	Faint, disagreeable odor; bitter, alkaline, repulsive taste; alkaline reaction.	2 parts, with the exception of a small residue.	Partly soluble in alcohol, leaving undissolved the accompanying impurities.

Test.	Quantitative Test.
If a solution of the salt be boiled with an excess of hydrochloric acid, until no more hydrosulphuric acid is given off, the cold filtrate, after being neutralized with soda, yields a white, crystalline precipitate with a saturated solution of bitartrate of sodium.	On triturating together 10 parts of sulphurated potassa and 12.69 parts of crystallized sulphate of copper with 60 parts of water, and filtering, the filtrate should remain unaffected by hydrosulphuric acid (presence of at least 56 per cent. of true sulphide of potassium).

The addition of the solution of sodium bitartrate identifies the potassium salt by forming a white, crystalline precipitate of potassium bitartrate. The quantitative test depends for its action upon the decomposition of a certain amount of cupric sulphate. If the officinal percentage of potas-

sium sulphide is present (56 per cent.), the quantity of copper in the cupric sulphate taken (12.69 parts) will be entirely converted into sulphide, so that no discoloration will be caused by the addition of hydrosulphuric acid.

$$\underset{\text{Potassium Sulphide.}}{K_2S_3} + \underset{\text{Cupric Sulphate.}}{CuSO_4} = \underset{\text{Potassium Sulphate.}}{K_2SO_4} + \underset{\text{Cupric Sulphide.}}{CuS} + \underset{\text{Sulphur.}}{S_2}.$$

Uses.—Sulphurated potassa is sometimes given internally, in five-grain doses. It is generally used externally, in skin diseases.

POTASSII ACETAS. *U. S.* Acetate of Potassium.

$KC_2H_3O_2$; 98.

Preparation.—This salt may be made by adding crystals of potassium bicarbonate to pure acetic acid until effervescence ceases, and, after acidulating slightly with a few drops of the acid, cautiously evaporating to dryness in a porcelain capsule by means of a sand-bath. Great care is necessary to avoid contamination with iron, and it is not safe to use an enamelled iron dish.

$$\underset{\text{Potassium Bicarbonate.}}{KHCO_3} + \underset{\text{Acetic Acid.}}{HC_2H_3O_2} = \underset{\text{Potassium Acetate.}}{KC_2H_3O_2} + \underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O}.$$

The manufacturer nearly always uses the carbonate in making potassium acetate, instead of the bicarbonate, because it is much cheaper. The product from the carbonate is not apt to be pure, however, because of the silica, sulphate, chlorides, etc., always present in the ordinary carbonate.

Potassii Acetas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
White; foliaceous, satiny, crystalline masses, or a white, granular powder, very deliquescent. When strongly heated, the salt melts; at a higher temperature it evolves empyreumatic, inflammable vapors, and leaves a blackened residue of an alkaline reaction.	Odorless; warming, mildly pungent, and saline taste; neutral or faintly alkaline reaction.	Cold. 0.4 part. Boiling. Very soluble.	Cold. 2.5 parts. Boiling. Very soluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. On adding sulphuric acid to the salt and heating, vapor of acetic acid is evolved. A cold solution of the salt is rendered deep red by ferric chloride, and, on boiling, a red precipitate is formed. If 4.9 Gm. of Acetate of Potassium are ignited until gases cease to be evolved, the alkaline residue should require, for complete neutralization, not less than 49 C.c. of the volumetric solution of oxalic acid (corresponding to at least 98 per cent. of absolute Acetate of Potassium).	Chloride.	A 2 per cent. aqueous solution of the salt, acidulated with acetic acid, should not yield more than a faint opalescence on the addition of test-solution of nitrate of silver.
	Sulphate.	A 2 per cent. aqueous solution of the salt, acidulated with acetic acid, should not yield more than a faint opalescence on the addition of test-solution of chloride of barium.
	Silica.	If a solution of the salt, acidulated with nitric acid, is evaporated to dryness, the residue should be completely soluble in water.
	Metals.	A solution of the salt, acidulated with nitric acid, should remain unaffected by hydrosulphuric acid or sulphide of ammonium.
	Alkaline Earths.	A solution of the salt, acidulated with nitric acid, should yield no precipitate, or at most only a trace, on the addition of test-solution of carbonate of sodium.
	Carbonate.	Fragments of the salt added to acetic acid should produce no effervescence.
	Organic Impurities.	Fragments of the salt sprinkled upon colorless, concentrated sulphuric acid should not impart any color to the latter.

Uses.—Acetate of potassium is a reliable diuretic when given in doses of twenty grains to one drachm. In larger doses it acts as a cathartic.

POTASSII BICARBONAS. *U. S.* Bicarbonate of Potassium.

$KHCO_3$; 100.

Preparation.—This salt is made by passing carbon dioxide through a solution of potassium carbonate until it is fully saturated, then filtering the liquid, and evaporating at a temperature below 71° C. (160° F.) to prevent decomposition. The crystals formed should be well washed and dried.

$$\underset{\text{Potassium Carbonate.}}{K_2CO_3} + \underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O} = \underset{\text{Potassium Bicarbonate.}}{2KHCO_3}.$$

The cheapest way to make this salt is to suspend a dish containing a concentrated solution of potassium carbonate within the fermenting tuns of a brewery: the carbon dioxide produced during fermentation is thus utilized. The crude salt obtained on evaporation is called *Salæratus*. When purified by crystallization, it constitutes the officinal bicarbonate.

Potassii Bicarbonas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, transparent, monoclinic prisms, permanent in dry air. At a red heat the salt loses 31 per cent. of its weight.	Odorless; saline and slightly alkaline taste; feebly alkaline reaction.	Cold. 3.2 parts. Decomposed by boiling water.	Almost insoluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution, on being heated, disengages carbonic acid gas, and finally contains carbonate of potassium. It effervesces on the addition of acids, and, with tartaric acid in excess, it produces a white, crystalline precipitate. To neutralize 5.0 Gm. of Bicarbonate of Potassium should require 50 C.c. of the volumetric solution of oxalic acid (corresponding to 100 per cent. of pure Bicarbonate of Potassium).	Sulphate.	When supersaturated with nitric acid, the aqueous solution should yield no precipitate with test-solution of chloride of barium.
	Chloride.	When supersaturated with nitric acid, the aqueous solution should yield at most only a slight cloudiness with test-solution of nitrate of silver.
	Carbonate.	If 1 Gm. of the salt be dissolved in 200 C.c. of cold water, and the solution be carefully mixed, without agitation, with a solution of 1.22 Gm. of chloride of barium in 200 C.c. of cold water, no precipitate or opalescence should make its appearance within ten minutes.

Uses.—This salt is largely used as affording the purest available source of the potassium salts. The large quantity of carbonic acid which it yields on decomposition renders it useful in beverages and laxative draughts, such as solution of magnesium citrate. It is milder than the carbonate, and when administered internally it is more acceptable to the stomach The dose is from fifteen to thirty grains.

POTASSII BICHROMAS. *U.S.* Bichromate of Potassium.

$K_2Cr_2O_7$; 294.8.

Preparation.—The source of this salt is *chrome iron ore*, which is found in several localities, notably in the neighborhood of Baltimore, Md. The ore is first roasted, then powdered, mixed with potassium carbonate and chalk, and the mixture heated strongly with access of air. The iron and chromium are both oxidized to ferric oxide and chromic acid; the latter attacks the potassium carbonate, and causes an evolution of carbon dioxide by combining with the potassium and forming neutral potassium chromate.

The solution of the latter is treated with an acid, usually sulphuric, but nitric acid would be preferable on some accounts, potassium nitrate being more readily separated from potassium bichromate than potassium sulphate. Sulphuric acid, however, is cheaper.

$$\underset{\text{Chrome Iron Ore.}}{2(FeOCr_2O_3)} + \underset{\text{Potassium Carbonate.}}{4K_2CO_3} + \underset{\text{Oxygen.}}{7O} = \underset{\text{Potassium Chromate.}}{4(K_2CrO_4)} + \underset{\text{Ferric Oxide.}}{Fe_2O_3} + \underset{\text{Carbon Dioxide.}}{4CO_2};$$

then

$$\underset{\text{Potassium Chromate.}}{2(K_2CrO_4)} + \underset{\text{Sulphuric Acid.}}{H_2SO_4} = \underset{\text{Potassium Bichromate.}}{K_2Cr_2O_7} + \underset{\text{Potassium Sulphate.}}{K_2SO_4} + \underset{\text{Water.}}{H_2O}.$$

This salt is sometimes called potassium dichromate, and is considered to be a compound of potassium chromate with chromic anhydride, K_2CrO_4,CrO_3.

Potassii Bichromas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Large, orange-red, transparent, four-sided tabular prisms, permanent in the air. The salt fuses below a red heat, forming a dark brown liquid, without loss of weight.	Odorless; bitter, disagreeable, metallic taste; acid reaction.	Cold. 10 parts. Boiling. 1.5 parts.	Insoluble.

Tests for Identity.	Impurities.	Test for Impurities.
At a white heat it evolves oxygen, and leaves a residue of neutral chromate of potassium and green chromic oxide, from which the former may be washed out by water. The aqueous solution yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. On heating the powdered salt with hydrochloric acid, chlorine vapor is given off.	Sulphate.	A 1 per cent. solution of the salt, acidulated with nitric acid, should not be precipitated nor be rendered cloudy on the addition of test-solution of chloride of barium.

Uses.—This salt is used in the preparation of chromic and valerianic acids, and for forming an officinal test-liquid, the value of which as an indicator depends upon its yielding its oxygen to acid liquids (see Test-Liquids). When given internally, in large doses, it is an irritant poison: the proper dose is one-fifth of a grain: soap, magnesia, or chalk would be a suitable antidote.

POTASSII BITARTRAS. *U.S.* **Bitartrate of Potassium.**
$KHC_4H_4O_6$; 188. [CREAM OF TARTAR.]

Preparation.—This well-known salt is made by purifying *argols*, or *tartar*, a substance deposited in wine-casks during the fermentation of the grape-juice. (See Acid Saccharine Fruits, Part IV.)

Potassii Bitartras. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless or slightly opaque, rhombic crystals, or a white, somewhat gritty powder, permanent in the air. When heated, the salt chars and evolves inflammable vapors having the odor of burnt sugar.	Odorless; pleasant acidulous taste; acid reaction.	Cold. 210 parts. Boiling. 15 parts.	Very slightly soluble.

Tests for Identity.	Impurities.	Tests for Impurities.
On moderate ignition, it leaves a blackened residue of an alkaline reaction, which strongly effervesces with acids. The salt is dissolved by warm solution of potassa, and is again precipitated on the addition of hydrochloric acid. Its aqueous solution, rendered neutral by potassa, produces, with test-solution of nitrate of silver, a white precipitate, becoming black by boiling.	Sulphate.	The aqueous solution of the salt, acidulated with nitric acid, should not be rendered turbid by test-solution of chloride of barium.
	Chloride.	The aqueous solution of the salt, acidulated with nitric acid, should not be rendered turbid by test-solution of nitrate of silver.
	Metals.	A solution of the salt in water of ammonia should remain unaffected by sulphide of ammonium.
	More than 6 per cent. of Tartrate of Calcium.	If 1 Gm. of Bitartrate of Potassium be digested with 5 C.c. of diluted acetic acid for half an hour, then diluted with distilled water to 500 C.c., the solution agitated and filtered, and 25 C.c. of the filtrate treated with 5 C.c. of test-solution of oxalate of ammonium, the liquid should not become cloudy in less than one minute, nor distinctly turbid in less than one minute and a half.

Calcium tartrate is always present in grape-juice, and it is permitted by the officinal test in potassium bitartrate if not in greater proportion than 6 per cent.

Uses.—This salt is the source of tartaric acid and some of the tartrates. It is one of the ingredients in compound powder of jalap, and is frequently used as a refrigerant and purgative in doses of one to four drachms.

POTASSII BROMIDUM. *U.S.* **Bromide of Potassium.**
KBr; 118.8.

Preparation.—Two methods are used in making this salt. In the one which was formerly officinal, ferrous bromide, made by acting on iron with bromine, is treated with potassium carbonate; ferrous carbonate precipitates, and potassium bromide remains in solution. The latter is filtered and evaporated, that crystals may form.

$$\underset{\text{Ferrous Bromide.}}{FeBr_2} + \underset{\text{Potassium Carbonate.}}{K_2CO_3} = \underset{\text{Ferrous Carbonate.}}{FeCO_3} + \underset{\text{Potassium Bromide.}}{2KBr.}$$

In the other method, bromine is added to solution of potassa, producing potassium bromide and bromate. The solution is evaporated to dryness, mixed with charcoal, and heated to redness. The bromate is deoxidized and converted into bromide, carbon monoxide escaping.

$$\underset{\text{Potassium Bromate.}}{2KBrO_3} + \underset{\text{Carbon.}}{3C_2} = \underset{\text{Potassium Bromide.}}{2KBr} + \underset{\text{Carbon Monoxide.}}{6CO.}$$

Formerly this salt was imported. It is now made in the United States upon a large scale, and is exported.

Potassii Bromidum. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, translucent, cubical crystals, permanent in dry air. The commercial salt generally appears in white, opaque or semi-transparent crystals, having a faintly alkaline reaction. At a dull red heat the salt melts without losing weight. At a full red heat it is slowly volatilized without decomposition.	Odorless; pungent, saline taste; neutral reaction.	Cold. 1.6 parts. Boiling. 1 part.	Cold. 200 parts. Boiling. 16 parts.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution of the salt yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. If disulphide of carbon be poured into a solution of the salt, then chlorine water added drop by drop, and the whole agitated, the disulphide will acquire a yellow or yellowish-brown color without a violet tint.	Bromate.	If diluted sulphuric acid be dropped upon crushed crystals of the salt, they should not at once assume a yellow color.
	Iodide.	If 1 Gm. of the salt be dissolved in 10 C.c. of water, some gelatinized starch added, and then a few drops of chlorine water be carefully poured on top, no blue zone should make its appearance at the line of contact of the two liquids.
	Sulphate.	On adding to 1 Gm. of the salt, dissolved in 20 C.c. of water, 5 or 6 drops of test-solution of nitrate of barium, no immediate cloudiness or precipitate should make its appearance.
1 Gm. of the powdered and dried salt, when completely precipitated by nitrate of silver, yields, if perfectly pure, 1.579 Gm. of dry bromide of silver.	More than 3 per cent. of Chloride.	If 3 Gm. of the well-dried salt be dissolved in distilled water to make 100 C.c., and 10 C.c. of this solution be treated with a few drops of test-solution of bichromate of potassium, and then volumetric solution of nitrate of silver be added, not more than 25.7 C.c. of the latter should be consumed before the red color ceases to disappear on stirring.
	More than 0.1 per cent. of Alkali.	Single crystals laid upon moistened red litmus paper should not at once produce a violet-blue stain.

The officinal test to indicate the presence of more than 3 per cent. of chloride depends upon the formation of red argentic chromate, which does not take place until after all of the chlorine has entered into combination with the silver.

Uses.—Potassium bromide is largely used as a nervine, in doses of twenty grains, frequently repeated.

POTASSII CARBONAS. *U. S.* Carbonate of Potassium.

$(K_2CO_3)_2.3H_2O$; 330.

Preparation.—This salt, known commercially as *Sal Tartar*, is made by dissolving pearlash, or impure potassium carbonate, in an equal weight of *cold water*, allowing the mixture to stand a day or two, filtering the solution, pouring it into a bright iron dish, and evaporating over a gentle fire until it thickens, then removing it from the fire and stirring constantly with an iron spatula, so as to form a granular salt (see page 213).

A purer carbonate is produced by decomposing potassium bicarbonate by heating to redness, thus driving off water of crystallization and a portion of the carbon dioxide.

$$\underset{\text{Potassium Bicarbonate.}}{2KHCO_3} = \underset{\text{Potassium Carbonate.}}{K_2CO_3} + \underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O}.$$

Potassii Carbonas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, crystalline or granular powder, very deliquescent at 15° C. (59° F.). At a red heat the salt loses between 15 and 18 per cent. of its weight, and at a bright red heat it melts. The aqueous solution strongly effervesces on the addition of acids, and with an excess of tartaric acid produces a white, crystalline precipitate.	Odorless; strongly alkaline taste; alkaline reaction.	Cold. 1 part. Boiling. 0.7 part.	Insoluble.

Quantitative Test.	Impurities.	Tests for Impurities.
To neutralize 3.45 Gm. of Carbonate of Potassium should require not less than 40.5 C.c. of the volumetric solution of oxalic acid (corresponding to at least 81 per cent. of pure anhydrous Carbonate of Potassium).	Silica, etc.	If a solution of the salt be supersaturated with nitric acid, and evaporated to dryness, a residue remains which should be soluble in water without leaving more than a trifling amount of insoluble matter.
	Alkaline Earths.	The above solution should not produce more than a cloudiness on the addition of test-solution of carbonate of sodium.
	Chloride.	An aqueous solution of the salt, supersaturated with nitric acid, should not be rendered more than slightly turbid by test-solution of nitrate of silver.
	Sulphate.	An aqueous solution of the salt, supersaturated with nitric acid, should not be rendered more than slightly turbid by test-solution of chloride of barium.

Uses.—Potassium carbonate is an antacid, but it is less agreeable than the bicarbonate. The dose is fifteen grains, largely diluted. In large doses it is an irritant caustic, the proper antidotes to administer being diluted vinegar, lemon-juice, or weak acids.

POTASSII CHLORAS. *U. S.* Chlorate of Potassium.

$KClO_3$; 122.4.

Preparation.—Chlorate of potash, as it is always termed commercially, was formerly made by passing chlorine gas into a solution of potassa. This is a very wasteful process, as only one-fifth of the potassa

is obtained as chlorate, the rest passing into potassium chloride. It is now more economically prepared by boiling together solutions of potassium chloride and calcium hypochlorite, whereby potassium chlorate and calcium chloride are produced.

When a solution of calcium hypochlorite is boiled, it is decomposed, and calcium chlorate and calcium chloride are formed:

$$\underset{\text{Calcium Hypochlorite.}}{3Ca(OCl)_2} = \underset{\text{Calcium Chloride.}}{2CaCl_2} + \underset{\text{Calcium Chlorate.}}{Ca(O_3Cl)_2}.$$

When solution of calcium chlorate is heated in contact with potassium chloride, double decomposition takes place, as shown by the following equation:

$$\underset{\text{Calcium Chlorate.}}{Ca(O_3Cl)_2} + \underset{\text{Potassium Chloride.}}{2KCl} = \underset{\text{Potassium Chlorate.}}{2KClO_3} + \underset{\text{Calcium Chloride.}}{CaCl_2}.$$

The potassium chlorate is easily separated from the calcium chloride, because it is much less soluble than the latter.

Potassii Chloras. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, monoclinic prisms or plates, of a pearly lustre, permanent in the air. Soluble in 16.5 parts of water at 15° C. (59° F.). When heated, the salt melts and afterwards gives off an abundance of oxygen, finally leaving a residue of a neutral reaction, amounting to 60.8 per cent. of the original weight, and completely soluble in water.	Odorless; cooling saline taste; neutral reaction.	Cold. 16.5 parts. Boiling. 2 parts.	Slightly soluble.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution of this residue yields a white, crystalline precipitate with a saturated solution of bitartrate of sodium, and, with test-solution of nitrate of silver, a white precipitate insoluble in nitric acid, but soluble in ammonia.	Sulphate.	A 1 per cent. aqueous solution of the salt should yield no precipitate with test-solution of chloride of barium.
	Calcium.	A 1 per cent. aqueous solution of the salt should yield no precipitate with test-solution of oxalate of ammonium.
	Chloride.	A 1 per cent. aqueous solution of the salt should yield at most only a faint cloudiness with test-solution of nitrate of silver.

Chlorate of potassium should not be triturated with readily oxidizable or combustible substances, if explosions are to be avoided.

Uses.—Potassium chlorate is used chemically as a source for obtaining oxygen, and medicinally is largely employed in diphtheria, sore throat, scarlet fever, etc., in doses of ten to twenty grains.

POTASSII CITRAS. *U. S.* Citrate of Potassium.

$K_3C_6H_5O_7.H_2O$; 324.

Preparation.—This salt is made by adding potassium bicarbonate to a solution of citric acid until effervescence ceases, filtering the solution, evaporating to dryness, and granulating (see page 213).

$$3KHCO_3 + H_3C_6H_5O_7 = K_3C_6H_5O_7 + 3H_2O + 3CO_2$$

Potassium Bicarbonate. — Citric Acid. — Potassium Citrate. — Water. — Carbon Dioxide.

Manufacturers generally use the carbonate as the source of the potassium, as it is much cheaper than the bicarbonate. When carelessly made from the carbonate, silica may be present, which is to be suspected if the potassium citrate is not entirely soluble in water.

Potassii Citras. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, granular powder, deliquescent on exposure to air. When heated to about 200° C. (392° F.), the salt loses nearly 5.5 per cent. of water. At a higher temperature it chars, and, if kept at a red heat, until gases cease to be evolved, it is converted into a blackened mass of an alkaline reaction, which strongly effervesces with acids.	Odorless; slightly cooling, faintly alkaline taste; neutral or faintly alkaline reaction.	Cold. 0.6 part. Boiling. Very soluble.	Very slightly soluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution of the salt yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. It remains clear on the addition of chloride of calcium until it is boiled, when a white, granular precipitate is produced. If 5.4 Gm. of Citrate of Potassium are ignited until gases cease to be evolved, the alkaline residue should require for complete neutralization not less than 50 C.c. of the volumetric solution of oxalic acid (corresponding to 100 per cent. of the pure Citrate of Potassium).	Carbonate.	The aqueous solution of the salt should not effervesce on the addition of an acid.
	Sulphate.	The aqueous solution of the salt, acidulated with nitric acid, should remain unaffected by test-solution of chloride of barium.
	Chloride.	The aqueous solution of the salt, acidulated with nitric acid, should remain unaffected by test-solution of nitrate of silver.
	Tartrate.	A concentrated solution of the salt should not deposit a white, crystalline precipitate on the addition of acetic acid.

Uses.—Potassium citrate is principally employed in medicine as a diaphoretic, in doses of twenty grains. It is found in the officinal solution of citrate of potassium and in the officinal mixture.

POTASSII CYANIDUM. *U.S.* Cyanide of Potassium.

KCN; 65.

Preparation.—A process for making this salt was formerly officinal. It is as follows: Take of Ferrocyanide of Potassium, dried, 8 *troyounces;* Pure Carbonate of Potassium, dried, 3 *troyounces.* Mix the salts intimately, and throw the mixture into a deep iron crucible previously heated to redness. Maintain the temperature until effervescence ceases, and the fused mass concretes, of a pure white color, upon a warm glass rod dipped into it. Then pour out the liquid carefully into a shallow dish to solidify, ceasing to pour before the salt becomes contaminated with the precipitated iron. Break up the mass while yet warm, and keep the pieces in a well-stopped bottle.

The reaction between the potassium ferrocyanide and the potassium carbonate results in the production of potassium cyanide, potassium cyanate, iron, and carbon dioxide. The iron is precipitated out in the form of a fine powder, carbon dioxide escapes, and potassium cyanide with a small proportion of cyanate, is produced.

$$\underset{\text{Potassium Ferrocyanide.}}{K_4Fe(CN)_6} + \underset{\text{Potassium Carbonate.}}{K_2CO_3} = \underset{\text{Potassium Cyanide.}}{5KCN} + \underset{\text{Potassium Cyanate.}}{KOCN} + \underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Iron.}}{Fe.}$$

Cyanide of potassium is found in commerce of several qualities. The cheapest grade is used for mining and metallurgical processes and in the arts. A granulated salt is used medicinally. It is sometimes cast into sticks, and in this form, of German manufacture, is of good quality. Chemically pure crystallized potassium cyanide is also in the market.

Potassii Cyanidum. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
White, opaque, amorphous pieces, or a white, granular powder, deliquescent in damp air. When heated to a low red heat, the salt fuses.	Odorless when perfectly dry, but generally of a peculiar, characteristic odor; sharp, somewhat alkaline and bitter-almond taste; strongly alkaline reaction.	Cold. 2 parts. Boiling. 1 part.	Sparingly soluble.

Tests for Identity.	Impurities.	Tests for Impurities.
Its aqueous solution yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. When exposed to the air, the solution exhales the odor of hydrocyanic acid, and, when added to test-solution of nitrate of silver, it yields a white precipitate which is wholly soluble in an excess of cyanide of potassium and also in water of ammonia.	Carbonate.	An aqueous solution of the salt should not produce more than a slight effervescence on the addition of an acid.
	Limit of Impurities.	If 0.65 Gm. of Cyanide of Potassium be dissolved in 12 C.c. of water, and volumetric solution of nitrate of silver be gradually added, the precipitate first formed should dissolve on stirring, and a permanent precipitate should not appear until at least 45 C.c. of the volumetric solution have been used (corresponding to at least 90 per cent. of pure Cyanide of Potassium).

Uses.—The action of this salt upon animals as a *poison* is the same as that of hydrocyanic acid. The dose is *one-eighth of a grain.* It is more stable than the acid, and is frequently used as a substitute for it.

POTASSII ET SODII TARTRAS. *U.S.* Tartrate of Potassium and Sodium.

$KNaC_4H_4O_6.4H_2O$; 282. [Rochelle Salt.]

Preparation.—This salt is made by adding potassium bitartrate to a solution of sodium carbonate: the proportions are shown by the former officinal process, which is as follows:

Take of Carbonate of Sodium, 12 *troyounces;* Bitartrate of Potassium, in fine powder, 16 *troyounces;* Boiling Water, 5 *pints.* Dissolve the Carbonate of Sodium in the Water, and gradually add the Bitartrate

of Potassium. Filter the solution, and evaporate until a pellicle begins to form; then set it aside to crystallize. Pour off the mother-water, and dry the crystals on bibulous paper. Lastly, evaporate the mother-water, that it may furnish more crystals.

It is advantageous to filter the solution after one-half of its volume has been evaporated and it has cooled and settled, in order to free it from the calcium tartrate which separates, otherwise the crystals will be contaminated.

The following equation shows the reaction:

$$\underset{\text{Potassium Bitartrate.}}{2KHC_4H_4O_6} + \underset{\text{Sodium Carbonate.}}{Na_2CO_3} = \underset{\text{Potassium and Sodium Tartrate.}}{2KNaC_4H_4O_6} + \underset{\text{Water.}}{H_2O} + \underset{\text{Carbon Dioxide.}}{CO_2}.$$

The chemical constitution of the tartrates will be fully explained under Acidum Tartaricum, but this opportunity will be embraced to note that tartaric acid is a dibasic acid; in its acid salts the hydrogen can be replaced by a base, which in this case is sodium.

Potassii et Sodii Tartras. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, transparent, rhombic crystals, slightly efflorescent in dry air, or a white powder. When rapidly heated to about 75° C. (167° F.), the salt melts in its water of crystallization; at a higher temperature it dries, then chars, evolves inflammable vapors having the odor of burnt sugar, and, on moderate ignition, leaves a blackened residue of an alkaline reaction, strongly effervescing with acids, and imparting to a non-luminous flame an intense yellow color, which appears red when observed through a blue glass.	Odorless; cooling, mildly saline and slightly bitter taste; neutral reaction.	Cold. 2.5 parts. Boiling. Very soluble.	Almost insoluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
A concentrated aqueous solution of the salt yields a white, crystalline precipitate on the addition of acetic acid. With test-solution of nitrate of silver it yields a white precipitate which becomes black on boiling. If 3.525 Gm. of Tartrate of Potassium and Sodium are ignited until gases cease to be evolved, the alkaline residue should require for complete neutralization not less than 25 C.c. of the volumetric solution of oxalic acid (corresponding to 100 per cent. of crystallized Tartrate of Potassium and Sodium).	Calcium.	A dilute aqueous solution should yield no precipitate with test-solution of oxalate of ammonium.
	Sulphate.	On adding nitric acid to a dilute aqueous solution of the salt, until the precipitate first formed is redissolved, the resulting solution should yield no precipitate with test-solution of chloride of barium.
	Chloride.	On adding nitric acid to a dilute aqueous solution of the salt, until the precipitate first formed is redissolved, the resulting solution should yield at most only a cloudiness with test-solution of nitrate of silver.
	Ammonium Salts.	A portion heated with potassa should not give off vapor of ammonia.

Uses.—Rochelle salt, as it is habitually termed, is an efficient purgative in the dose of half an ounce to an ounce. It is an important ingredient in the well-known Seidlitz powders.

POTASSII FERROCYANIDUM. *U.S.* Ferrocyanide of Potassium.

$K_4Fe(CN)_6.3H_2O$; 421.9.

Preparation.—When refuse animal substances which contain nitrogen are heated in an iron pot with crude pearlash, impure potassium cyanide is formed. If the fused mass is lixiviated and treated with freshly-precipitated ferrous carbonate, potassium ferrocyanide is produced, according to the following reaction:

$$\underset{\text{Potassium Cyanide.}}{6KCN} + \underset{\text{Ferrous Carbonate.}}{FeCO_3} = \underset{\text{Potassium Ferrocyanide.}}{K_4Fe(CN)_6} + \underset{\text{Potassium Carbonate.}}{K_2CO_3}.$$

This salt is important, because it is the source of all the cyanogen compounds used in medicine.

Potassii Ferrocyanidum. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Large, coherent, lemon-yellow, translucent and rather soft, four-sided prisms or tablets, slightly efflorescent in dry air. When gently heated, the salt becomes white; and at 100° C. (212° F.) it becomes anhydrous, losing 12.8 per cent. of its weight.	Odorless; sweetish and saline taste; neutral reaction.	Cold. 4 parts. Boiling. 2 parts.	Insoluble.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium, a dark blue precipitate with ferric salts, a bluish-white precipitate, gradually turning darker, with ferrous salts, a red-brown precipitate with salts of copper, and a white one with acetate of lead.	Carbonate.	A concentrated aqueous solution of the salt should not effervesce on the addition of diluted sulphuric acid.
	Sulphate.	A diluted aqueous solution of the salt, when acidulated with hydrochloric acid, should not yield more than a trifling precipitate or cloudiness with chloride of barium.
	Chloride.	If equal parts of the salt and of nitrate of potassium be cautiously deflagrated in a porcelain crucible, the residue extracted with water, and to the filtered solution, acidulated with nitric acid, test-solution of nitrate of silver be added, not more than a faint white opalescence should make its appearance.

Uses.—This salt is rarely employed medicinally: it is *not poisonous* if pure. Chemically, it is important as furnishing a reliable test for ferric salts.

POTASSII HYPOPHOSPHIS. *U.S.* Hypophosphite of Potassium.

KH_2PO_2; 104.

Preparation.—When solutions of calcium hypophosphite and potassium carbonate are mixed, potassium hypophosphite and calcium carbonate are produced by double decomposition, thus:

$$\underset{\text{Calcium Hypophosphite.}}{Ca2H_2PO_2} + \underset{\text{Potassium Carbonate.}}{K_2CO_3} = \underset{\text{Potassium Hypophosphite.}}{2KH_2PO_2} + \underset{\text{Calcium Carbonate.}}{CaCO_3}.$$

The calcium carbonate is removed by filtration, and the clear solution is evaporated till a pellicle forms, after which it is constantly stirred,

with continuance of the heat, until the salt granulates. The heat employed in the evaporation should be kept considerably below 100° C. (212° F.), for fear of explosion. If the salt is required quite pure, it should be dissolved in the granulated state, in officinal alcohol, and the solution evaporated to a syrupy consistence, and then set aside to crystallize.

Potassii Hypophosphis. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
White, opaque, confused-crystalline masses, or a white, granular powder, very deliquescent. When heated in a dry test-tube, the salt loses adhering moisture, then evolves a spontaneously inflammable gas (phosphoretted hydrogen). On triturating or heating the salt with an oxidizing agent, the mixture will explode.	Odorless; sharp, saline, slightly bitter taste; neutral reaction.	Cold. 0.6 part. Boiling. 0.3 part.	Cold. 7.3 parts. Boiling. 3.6 parts.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution of the salt yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. With test-solution of nitrate of silver it yields a white precipitate which rapidly turns brown and black, separating metallic silver. Acidulated with hydrochloric acid and added to excess of test-solution of mercuric chloride, it first produces a white precipitate of calomel, and, on further addition, causes the separation of metallic mercury.	Carbonate.	The aqueous solution of the salt should not effervesce on the addition of an acid.
	Calcium.	The aqueous solution of the salt should not be precipitated or rendered cloudy by test-solution of oxalate of ammonium.
	Sulphate.	When the aqueous solution of the salt is acidulated with hydrochloric acid, it should not produce a white precipitate or cloudiness with test-solution of chloride of barium.
	Phosphate.	On mixing the aqueous solution of the salt with test-solution of magnesium, not more than a slight cloudiness should make its appearance.

Uses.—The only officinal use made of potassium hypophosphite is to form one of the ingredients of the largely-used syrup of the hypophosphites. It may be given internally in the dose of fifteen grains.

POTASSII IODIDUM. *U. S.* Iodide of Potassium.

KI; 165 6.

Preparation.—An aqueous solution of potassa is treated with iodine in slight excess. The result is the formation of two salts, iodide and iodate of potassium.

$$\underset{\text{Potassium Hydrate.}}{6KOH} + \underset{\text{Iodine.}}{(I_2)_3} = \underset{\text{Potassium Iodide.}}{5KI} + \underset{\text{Potassium Iodate.}}{KIO_3} + \underset{\text{Water.}}{3H_2O}.$$

By evaporating the solution to dryness the mixed salts are obtained; and, if the dry mass be exposed to a red heat, the iodate will be converted into iodide of potassium, thus removing this impurity from the iodide.

The mixed salts, towards the close of their evaporation to dryness, should be mixed with powdered charcoal, which facilitates the deoxida-

tion of the iodate. This being accomplished by a dull red heat, the iodide of potassium is dissolved out of the mass, and the solution is set aside to crystallize.

Potassium iodide is always crystallized from an alkaline solution if the manufacturer expects to avoid loss through the discoloration of the product from the separation of free iodine. The officinal test permits the presence of a small excess of alkali.

Potassii Iodidum. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, translucent, cubical crystals, slightly deliquescent. The commercial salt generally appears in white, opaque crystals, having a faintly alkaline reaction; but single crystals laid upon moistened red litmus paper should not at once produce a violet-blue stain (absence of more than about 0.1 per cent. of alkali). At a dull red heat the salt melts without losing weight. At a full red heat it is slowly volatilized without decomposition.	Peculiar, faint odor; pungent, saline, afterwards somewhat bitter taste; neutral reaction.	Cold. 0.8 part. Boiling. 0.5 part.	Cold. 18 parts. Boiling. 6 parts.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution of the salt yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. If disulphide of carbon be poured into a solution of the salt, then chlorine water added drop by drop, and the whole agitated, the disulphide of carbon will acquire a violet color.	Iodate.	The aqueous solution of the salt, mixed with gelatinized starch and afterwards with diluted sulphuric acid, should not at once acquire a blue color.
1 Gm. of the powdered and dried salt, when completely precipitated by nitrate of silver, yields, if perfectly pure, 1.415 Gm. of dry iodide of silver.	More than about 0.5 per cent. of Chloride or Bromide.	If 1 Gm. of the salt be dissolved in 10 C.c. of water of ammonia, then shaken with a solution of 1.1 Gm. of nitrate of silver in 20 C.c. of water, and the filtrate be supersaturated with 7 C.c. of nitric acid, no cloudiness should make its appearance within ten minutes.
	Sulphate.	On adding to 1 Gm. of the salt, dissolved in 30 C.c. of water, 5 or 6 drops of test-solution of nitrate of barium, no immediate cloudiness or precipitate should make its appearance.

Uses.—This is the most valuable medicinal compound of iodine, if the extent to which it is employed is a criterion. It is used as an alterative in five-grain doses; as an antisyphilitic, four drachms, largely diluted, may be given.

POTASSII NITRAS. *U.S.* Nitrate of Potassium.

KNO_3; 101.

Preparation.—*Nitre*, or *Saltpetre*, is sometimes a natural product; usually, however, it is produced artificially in what are known as nitre-beds, which are made up of earth and wood-ashes, with animal and vegetable refuse: these are protected from rain by sheds. In time the ammonia, produced by the decomposition of the organic matter in the mixture, is oxidized, nitric acid is formed, which unites with the potassa in the wood-ashes, and potassium nitrate is gradually formed: this is

separated by lixiviation, filtration, evaporation, and crystallization. It is generally imported from Europe or India in a crude state and refined in this country.

Potassii Nitras. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, transparent, six-sided, rhombic prisms, or a crystalline powder, permanent in the air. When heated to about 340° C. (644° F.), the salt melts; at a higher temperature it is decomposed, giving off oxygen, and leaving a residue which emits nitrous vapors on the addition of sulphuric acid. Thrown upon red-hot coals, the salt deflagrates.	Odorless; cooling, saline, and pungent taste; neutral reaction.	Cold. 4 parts. Boiling. 0.4 part.	Almost insoluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution of the salt yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. If 1 Gm. of the dried salt be moistened with 1 Gm. of concentrated sulphuric acid, and the mixture be kept at a red heat until it ceases to lose weight, the residue should weigh 0.86 Gm.	Metals.	The aqueous solution of the salt should remain unaffected by hydrosulphuric acid or sulphide of ammonium.
	Alkaline Earths.	The aqueous solution should remain unaffected by test-solution of carbonate of ammonium.
	Sulphate.	If an aqueous solution of the salt is previously acidulated with nitric acid, it should yield no precipitate or cloudiness with test-solution of nitrate of barium.
	Chloride.	If an aqueous solution of the salt is previously acidulated with nitric acid, it should yield at most only a faint opalescence with test-solution of nitrate of silver.

Uses.—Nitrate of potassium is diuretic and diaphoretic in doses of ten to twenty grains. In concentrated solution it is antiseptic. It is most largely used in making gunpowder.

POTASSII PERMANGANAS. *U.S.* Permanganate of Potassium.

$K_2Mn_2O_8$; 314.

Preparation.—This salt may be prepared by the British process, which is as follows:

Take of Caustic Potash 5 oz. av.; Black Oxide of Manganese, in fine powder, 4 oz. av.; Chlorate of Potash 3½ oz. av.; Diluted Sulphuric Acid a sufficiency; Distilled Water 2½ pints (Imp. measure). Reduce the Chlorate of Potash to fine powder, and mix it with the Oxide of Manganese; put the mixture into a porcelain basin, and add to it the Caustic Potash, previously dissolved in 4 fl. oz. of the Water. Evaporate to dryness on a sand-bath, stirring diligently to prevent spurting. Pulverize the mass, put it into a covered Hessian or Cornish crucible, and expose it to a dull red heat for an hour, or till it has assumed the condition of a semi-fused mass. Let it cool, pulverize it, and boil with 1½ pints of the Water. Let the insoluble matter subside, decant the fluid, boil again with ½ pint of the Water, again decant, neutralize the united liquors accurately with the Diluted Sul-

phuric Acid, and evaporate till a pellicle forms. Set aside to cool and crystallize. Drain the crystalline mass, boil it in 6 fl. oz. of the Water and strain through a funnel, the throat of which is lightly obstructed by a little asbestos. Let the fluid cool and crystallize, drain the crystals, and dry them by placing them under a bell-jar over a vessel containing sulphuric acid.

By this process potassium chlorate yields oxygen to manganese dioxide, converting it into manganic acid, which unites with the potassa to form the manganate, potassium chloride being formed at the same time.

$$\underset{\text{Manganese Dioxide.}}{3MnO_2} + \underset{\text{Potassium Hydrate.}}{6KHO} + \underset{\text{Potassium Chlorate.}}{KClO_3} = \underset{\text{Potassium Manganate.}}{3K_2MnO_4} + \underset{\text{Potassium Chloride.}}{KCl} + \underset{\text{Water.}}{3H_2O}.$$

When this solution is boiled with water, the potassium manganate is converted into potassium permanganate, according to the following reaction:

$$\underset{\text{Potassium Manganate.}}{3K_2MnO_4} + \underset{\text{Water.}}{3H_2O} = \underset{\text{Potassium Permanganate.}}{K_2Mn_2O_8} + \underset{\text{Manganese Peroxide.}}{MnO_3H_2} + \underset{\text{Potassium Hydrate.}}{4KHO}.$$

The potassium hydrate liberated by the reaction requires neutralization with an acid if all the permanganate is to be obtained, because the latter, in the presence of an excess of potassa, remains in the condition of manganate.

Potassii Permanganas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Deep purple-violet, or nearly black, needle-shaped, rhombic prisms, of a metallic lustre, permanent in the air. When heated to redness, the salt gives off oxygen and leaves a black residue of an alkaline reaction.	Odorless; sweet, afterwards disagreeable, astringent taste; neutral reaction.	Cold. 20 parts, with the exception of a scanty brown residue. Boiling. 3 parts.	Cold. Decomposed. Boiling. Decomposed.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
A very dilute solution of the salt has a rose color without a tinge of green. This color is destroyed by the addition of oxalic acid, or of many other organic or readily oxidizable substances, with the formation of a brown precipitate, soluble in diluted sulphuric acid, forming a colorless liquid. If 0.785 Gm. of the salt be dissolved in 50 C.c. of boiling distilled water and 5 C.c. of sulphuric acid be cautiously added, the solution so formed should require for complete decoloration not less than 24.7 C.c. of the volumetric solution of oxalic acid (corresponding to at least 98.8 per cent. of pure Permanganate of Potassium).	Nitrate.	If a solution of the salt be mixed with enough oxalic and diluted sulphuric acid to produce a clear, colorless liquid, and a portion of this be poured upon a cold solution of ferrous sulphate in sulphuric acid, no brown or blackish-brown zone should make its appearance at the line of contact of the two liquids.
	Chloride.	If a solution of the salt be mixed with enough oxalic and diluted sulphuric acid to produce a clear, colorless liquid, it should yield no permanent precipitate or cloudiness on the addition of a few drops of test-solution of nitrate of silver.
	Sulphate.	On boiling an aqueous solution of the salt with an excess of ammonia, until all the manganese is precipitated as hydrated oxide, the colorless filtrate, acidulated with nitric acid, should yield no precipitate, or at most only a faint cloudiness, with test-solution of nitrate of barium.

Uses.—Potassium permanganate is one of the most powerful oxidizing agents known, and it is for this reason that the cautionary officinal note is appended, "It should not be triturated nor combined in solution with organic or readily oxidizable substances." It is owing to the facility with which it parts with oxygen, when in contact with organic matter, that it is useful as a disinfectant: hence when used externally its application by means of lint, towels, etc., should be avoided, because its energy would be spent upon these instead of upon the part of the body intended to be affected by it. Chemically, it is used as a volumetric test and oxidizer, for which it is admirably adapted on account of the distinctness of its color reactions, although the difficulty of keeping the solution from partial decomposition through the action of light and air is a serious annoyance and interferes with the accuracy of the estimation.

POTASSII SULPHAS. *U. S.* Sulphate of Potassium.

K_2SO_4; 174.

Preparation.—Sulphate of potassium is obtained as a by-product in many chemical processes, although since the introduction of sodium nitrate as the source of the nitrates it is not produced very largely. It is also obtained from *kainite*, the mineral found in the Stassfurt salt-beds, which is a double sulphate of potassium and magnesium. If it should be necessary to make it directly at any time, it can be made by decomposing potassium nitrate with sulphuric acid.

$$\underset{\text{Potassium Nitrate.}}{2KNO_3} + \underset{\text{Sulphuric Acid.}}{H_2SO_4} = \underset{\text{Potassium Sulphate.}}{K_2SO_4} + \underset{\text{Nitric Acid.}}{2HNO_3}.$$

Potassii Sulphas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, hard, six-sided, rhombic prisms, permanent in the air. When heated, the crystals decrepitate, and at a white heat they fuse, solidifying, on cooling, to a crystalline mass of an alkaline reaction.	Odorless; sharp, saline, slightly bitter taste; neutral reaction.	Cold. 9 parts. Boiling. 4 parts.	Insoluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. With test-solution of chloride of barium it yields a white precipitate, insoluble in nitric acid.	Alkaline Earths.	The aqueous solution of the salt should not be precipitated, nor be rendered cloudy, by test-solution of carbonate of ammonium, nor by test-solution of phosphate of sodium with addition of ammonia.
1 Gm. of Sulphate of Potassium, when completely precipitated by chloride of barium, yields 1.338 Gm. of dry sulphate of barium.	Metals.	The aqueous solution of the salt should remain unaffected by hydrosulphuric acid or sulphide of ammonium.
	Chloride.	The aqueous solution of the salt should not be precipitated or rendered cloudy by test-solution of nitrate of silver.

Uses.—The principal use for potassium sulphate in pharmacy has been to act as a diluent in powdering ipecac and opium in the so-called Dover's powder. It is well adapted for this purpose, for, on account

of the hardness of the crystals, the ingredients are thoroughly blended during the time required to produce a fine powder. Sugar of milk is employed now as a substitute for it, although many still continue to use potassium sulphate.

POTASSII SULPHIS. *U. S.* Sulphite of Potassium.

$K_2SO_3.2H_2O$; 194.

Preparation.—Neutral potassium sulphite is made by passing sulphurous acid gas through a strong solution of potassium carbonate until the carbon dioxide is expelled and the liquid is strongly acid, and then forming the neutral sulphite by the addition of an equal weight of potassium carbonate, evaporating the solution, and crystallizing.

$$\underset{\text{Potassium Carbonate.}}{K_2CO_3} + \underset{\text{Sulphurous Acid.}}{SO_2} = \underset{\text{Potassium Sulphite.}}{K_2SO_3} + \underset{\text{Carbon Dioxide.}}{CO_2}.$$

The solution should be cautiously but quickly evaporated, to prevent the formation of more sulphate than is unavoidable.

Potassii Sulphis. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
White, opaque, obliquely rhombic, octahedral crystals, or a crystalline powder, somewhat deliquescent. When gently heated, the salt loses its water of crystallization (18.5 per cent.); at a red heat it is decomposed and leaves a residue of an alkaline reaction.	Odorless; bitter, saline, and sulphurous taste; neutral or feebly alkaline reaction.	Cold. 4 parts. Boiling. 5 parts.	Sparingly soluble.

Tests for Identity and Quantitative Test.	Impurities.	Test for Impurities.
The aqueous solution of the salt yields a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium. Addition of diluted hydrochloric acid to the aqueous solution gives rise to the odor of burning sulphur, and the solution does not become cloudy (difference from hyposulphite). If 0.485 Gm. of the salt be dissolved in 25 C.c. of water, and a little gelatinized starch added, at least 45 C.c. of the volumetric solution of iodine should be required, until a permanent blue tint appears after stirring (corresponding to at least 90 per cent. of pure Sulphite of Potassium).	Sulphate.	A 1 per cent. aqueous solution of the salt, strongly acidulated with hydrochloric acid, should produce no precipitate, or at most only a white cloudiness, on the addition of a few drops of test-solution of chloride of barium.

Uses.—This salt, in doses of fifteen to sixty grains, is used as an antiferment, and to destroy the lower forms of organic life.

POTASSII TARTRAS. *U.S.* Tartrate of Potassium.

$(K_2C_4H_4O_6)_2.H_2O$; 470.

Preparation.—Neutral potassium tartrate may be made by the following process:

Carbonate of Potassium 4 oz. av.; Bitartrate of Potassium, in fine powder, 9 oz. av., or a sufficient quantity; Boiling Water 2 pints. Dissolve the Carbonate of Potassium in the Water; then gradually add Bitartrate of Potassium to the solution until it is completely saturated,

and boil. Filter the liquid, evaporate it until a pellicle forms, and set it aside to crystallize. Lastly, pour off the mother-water, and, having dried the crystals on bibulous paper, keep them in a well-stopped bottle.

The rationale of the process is that the hydrogen present in the acid potassium tartrate is replaced by one atom of potassium and the neutral tartrate is produced.

$$\underset{\text{Acid Potassium Tartrate.}}{2KHC_4H_4O_6} + \underset{\text{Potassium Carbonate.}}{K_2CO_3} = \underset{\text{Potassium Tartrate.}}{2K_2C_4H_4O_6} + \underset{\text{Water.}}{H_2O} + \underset{\text{Carbon Dioxide.}}{CO_2}.$$

The precipitate which is formed, and which must be filtered out, is the calcium tartrate, always found in potassium bitartrate.

Potassii Tartras. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Small, transparent or white, monoclinic crystals, or a white powder, somewhat deliquescent. When heated, the salt melts, then chars, and evolves inflammable vapors having the odor of burnt sugar. On moderate ignition, it leaves a blackened residue of an alkaline reaction, strongly effervescing with acids.	Odorless; saline, slightly bitter taste; neutral reaction.	Cold. 0.7 part. Boiling. 0.5 part.	Almost insoluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
A concentrated aqueous solution of the salt yields a white, crystalline precipitate on the addition of acetic acid. With test-solution of nitrate of silver it yields a white precipitate which becomes black on boiling. If 2.938 Gm. of Tartrate of Potassium are ignited till gases cease to be evolved, the alkaline residue should require, for complete neutralization, not less than 25 C.c. of the volumetric solution of oxalic acid (corresponding to 100 per cent. of pure Tartrate of Potassium).	Calcium.	A 10 per cent. aqueous solution of the salt should yield no precipitate with test-solution of oxalate of ammonium.
	Sulphate.	On adding nitric acid to a 1 per cent. solution of the salt, until the precipitate first formed is redissolved, the resulting solution should yield no precipitate with test-solution of chloride of barium.
	Chloride.	On adding nitric acid to a 1 per cent. solution of the salt, until the precipitate first formed is redissolved, the resulting solution should yield at most only a cloudiness with test-solution of nitrate of silver.

Uses.—Neutral potassium tartrate is used medicinally as a purgative, in doses of from two drachms to one ounce. Chemically, it enters into Fehling's solution, the well-known test for glucose.

LIQUOR POTASSII CITRATIS. *U.S.* **Solution of Citrate of Potassium.**

	By measure.
Citric Acid, 6 parts, or	360 grains.
Bicarbonate of Potassium, 8 parts, or	480 grains.
Water, a sufficient quantity,	
To make	12 fl. oz.

Dissolve the Citric Acid and the Bicarbonate of Potassium, each, in *forty parts* [or 5½ fl. oz.] of Water. Filter the solutions separately, and wash the filters with enough Water to obtain, in each case, *fifty*

parts [or 6 fl. oz.] of solution. Finally, mix the two solutions, and, when effervescence has ceased, transfer the liquid to a bottle. This preparation should be freshly made when wanted for use.

For this preparation it will be found convenient in dispensing practice to keep the separate solutions of citric acid and bicarbonate of potassium on hand ready to be mixed when the solution of citrate of potassium is needed. The solutions keep moderately well, and the alternative process, by measure, will be found most useful. It is officinally described as a clear, colorless liquid, odorless, having a mildly saline taste and a slightly acid reaction. Sp. gr. 1.059. The solution contains about 9 per cent. of citrate of potassium, with some free citric acid and carbonic acid gas. It responds to the reactions and tests of citrate of potassium (see Potassii Citras).

Uses.—Solution of citrate of potassium is refrigerant and diaphoretic, in doses of one fluidrachm.

MISTURA POTASSII CITRATIS. *U.S.* **Mixture of Citrate of Potassium.**
[NEUTRAL MIXTURE.]

This mixture differs from Liquor Potassii Citratis in being made from lemon-juice instead of solution of citric acid: it is more agreeable to the taste on this account than the former, and it is always to be preferred to it. It is used as a refrigerant and diaphoretic, in doses of one fluidrachm (see page 274).

CHAPTER XXXIX.

THE SODIUM SALTS.

THE sodium salts are generally more frequently used than those having potassium for their base, because they are relatively cheaper, and are often more soluble. The metal *Sodium* is a soft, malleable, ductile solid, which must be protected from the oxygen of the air by being constantly immersed in petroleum or naphtha.

Tests for Sodium Salts.

Sodium may be recognized in its salts by the following reactions:

1. The intensely yellow color produced when even a trace of a sodium compound is introduced into a colorless flame.

2. A reliable and practical precipitant is yet to be discovered for the sodium salts, because the compounds are generally very soluble. Neutral solutions may be precipitated by potassium metantimoniate: this reaction, however, has but a limited application.

3. Sodium salts are generally colorless, and not volatile below a red heat.

Officinal Preparations of Sodium.

Officinal Name. With Inorganic Radicals.	Preparation.
Soda	By boiling solution of sodium carbonate with calcium hydrate and evaporating.
Sodii Arsenias	By heating together arsenious acid, sodium nitrate, and sodium carbonate.
Sodii Bicarbonas	By washing commercial sodium bicarbonate with water.
Sodii Bicarbonas Venalis	By exposing sodium carbonate to the action of carbon dioxide.
Sodii Bisulphis	By saturating a solution of sodium carbonate with sulphurous acid.
Sodii Boras	By purifying the native salt.
Sodii Bromidum	By treating ferrous bromide with sodium carbonate.
Sodii Carbonas	By heating sodium sulphate with chalk and coal.
Sodii Carbonas Exsiccatus	By heating the carbonate.
Sodii Chloras	By double decomposition between sodium bitartrate and potassium chlorate.
Sodii Chloridum	By evaporating sea-water.
Sodii Hypophosphis	By double decomposition between calcium hypophosphite and sodium carbonate.
Sodii Hyposulphis	By decomposing calcium thiosulphate with sodium sulphate.
Sodii Iodidum	By treating ferrous iodide with sodium carbonate.
Sodii Nitras	By purifying the native salt.

Officinal Preparations of Sodium.—(*Continued.*)

Officinal Name.	Preparation.
With Inorganic Radicals.	
Sodii Phosphas	By treating acid calcium phosphate with sodium carbonate.
Sodii Pyrophosphas	By heating sodium phosphate to redness, dissolving and crystallizing.
Sodii Sulphas	By treating common salt with sulphuric acid.
Sodii Sulphis	By decomposing sodium carbonate with sulphurous acid.
Liquor Sodæ	By dissolving sodium hydrate in water.
Liquor Sodæ Chloratæ	Double decomposition between chlorinated lime and sodium carbonate.
Liquor Sodii Arseniatis	1 per cent. solution of sodium arseniate.
Liquor Sodii Silicatis	Solution of sodium silicate.
Trochisci Sodii Bicarbonatis	Each contains three grains of sodium bicarbonate.
With Organic Radicals.	
Sodii Acetas	By decomposing sodium carbonate with acetic acid.
Sodii Benzoas	By decomposing sodium carbonate with benzoic acid.
Sodii Salicylas	By decomposing sodium carbonate with salicylic acid.
Sodii Santoninas	By adding santonin to hot solution of sodium carbonate.
Sodii Sulphocarbolas	By double decomposition between barium sulphocarbolate and sodium carbonate.
Trochisci Sodii Santoninatis	Each contains one grain of sodium santoninate.
Mistura Rhei et Sodæ	Contains sodium bicarbonate.

Unofficinal Preparations of Sodium.

Sodii Carbolas, NaC_6H_5O, = 116. Carbolate of Sodium.	Add metallic sodium to carbolic acid, and allow it to crystallize.
Sodii Citras, $2C_6H_5Na_3O_7.11H_2O$, = 912. Citrate of Sodium.	Saturate a solution of citric acid with sodium bicarbonate, evaporate, and allow it to crystallize.
Sodii Citro-Tartras Effervescens. Effervescent Citro-tartrate of Sodium.	17 p. sodium bicarbonate; 8 p. tartaric acid; 6 p. citric acid. Mix, and place in a dish heated to about 200° F. Stir constantly until a granular salt is obtained. Lastly, sift it.
Sodii et Ammonii Phosphas, $NH_4NaHPO_4.4H_2O$, = 209. Phosphate of Sodium and Ammonium.	Dissolve 5 p. crystallized sodium phosphate and 2 p. ammonium phosphate in 20 p. hot water; then add water of ammonia until the liquid is alkaline, and crystallize.
Sodii et Argenti Hyposulphis. Hyposulphite of Sodium and Silver.	Dissolve freshly precipitated silver oxide in a solution of hyposulphite of sodium, and evaporate to crystallize.
Sodii Nitro-Prussidum, $Na_2Fe(CN)_5NO.2H_2O$, = 297.9. Nitro-prusside of Sodium.	Digest 1 p. potassium ferrocyanide with 2 p. nitric acid and 2 p. water until it ceases to produce a blue precipitate with iron salts. When cool, neutralize mother-liquid with sodium carbonate, then collect the red crystals.
Sodii Nitris, $NaNO_2$, = 69. Nitrite of Sodium.	Introduce carefully into a heated iron crucible a mixture of 7 p. sodium nitrate and 1 p. starch. Dissolve the residue in water, and evaporate.
Sodii et Platini Chloridum, $2NaCl.PtCl_4.6H_2O$, = 801.4. Chloride of Sodium and Platinum.	Dissolve 3 p. platinic chloride and 5 p. sodium chloride in water, and evaporate to dryness, stirring continually.
Sodii Silicas, Na_2SiO_3, = 122. Silicate of Sodium.	Mix 1 p. silica and 2 p. dried sodium carbonate; fuse in an earthen-ware crucible, and pour the mass on a slab. Dissolve in water, filter, and concentrate to crystallize.
Sodii Stannas, Na_2SnO_3, = 211.7. Stannate of Sodium.	Fuse tin-ore with soda and sodium nitrate.
Sodii Tartras, $Na_2C_4H_4O_6.2H_2O$, = 226. Tartrate of Sodium.	Dissolve 6 p. tartaric acid and 7½ p. sodium bicarbonate, each separately in water. Mix the solutions, filter, and concentrate to crystallize.
Sodii Valerianas, $NaC_5H_9O_2$, = 124. Valerianate of Sodium.	Saturate valerianic acid with sodium carbonate.

SODA. *U.S.* Soda.

NaHO; 40.

Preparation.—Owing to the improvements in the manufacture of metallic sodium and the cheapening of the product, soda can be found in commerce which has been made by oxidizing the metal by bringing it in contact with water and evaporating the pure solution of soda. When the pure hydrate is not needed, the white caustic soda, in sticks, made by evaporating a solution of soda (see Liquor Sodæ) and casting the fused residue into moulds, is used. (See Potassa, page 445.)

Soda. U.S.	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, hard, opaque solid, generally in form of fibrous pieces, or of white cylindrical pencils, deliquescent in moist air, but in dry air becoming dry and efflorescent. When heated nearly to a red heat, it melts, forming an oily liquid. At a strong red heat it is slowly volatilised unchanged.	Odorless; intensely acrid and caustic taste; strongly alkaline reaction.	Cold. 1.7 parts. Boiling. 0.8 part.	Very soluble.

Test for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
Its aqueous solution dropped into solution of tartaric acid, so that the latter remains in excess, produces neither a precipitate nor cloudiness. To neutralize 2.0 Gm. of Soda should require not less than 45 C.c. of the volumetric solution of oxalic acid (corresponding to at least 90 per cent. of absolute hydrate of sodium).	Organic Matter.	The aqueous solution of soda should be colorless.
	Chloride.	An aqueous solution of soda, after being supersaturated with nitric acid, should not be more than slightly clouded on the addition of test-solution of nitrate of silver.
	Sulphate.	An aqueous solution of soda, after being supersaturated with nitric acid, should not be more than slightly clouded on the addition of test-solution of chloride of barium.
	Carbonate.	Solution of soda dropped into an acid should not produce more than a faint effervescence of isolated bubbles.
	Silica or Carbonate.	If soda be dissolved in 2 parts of water and the solution dropped into alcohol, not more than a slight precipitate should make its appearance.

Uses.—*Caustic Soda*, as it is termed commercially, is sometimes preferred to the analogous potassium salt, in the belief that it is milder and less deliquescent. It is used pharmaceutically in making solution of soda by the *alternative* process.

LIQUOR SODÆ. *U.S.* Solution of Soda.

An aqueous solution of hydrate of sodium [NaHO; 40], containing about 5 per cent. of the hydrate.

	By measure.
Carbonate of Sodium, 180 parts, or	5 oz. av.
Lime, 60 parts, or	1½ oz. av.
Distilled Water, a sufficient quantity,	
To make 1000 parts, or	1½ pints.

Dissolve the Carbonate of Sodium in *four hundred parts* [or 10 fl. oz.] of boiling, Distilled Water. Slake the Lime and make it into a smooth mixture with *four hundred parts* [or 10 fl. oz.] of Distilled Water, and heat it to boiling. Then gradually add the first liquid to the second, and continue the boiling for ten minutes. Remove the heat, cover the vessel tightly, and, when the contents are cold, add enough Distilled Water to make the whole mixture weigh *one thousand parts* [or measure 1½ pints]. Lastly, strain it through linen, set the liquid aside until it is clear, and remove the clear solution by means of a syphon.

Alternative Process.

Soda, 56 parts, or	1 oz. av.
Distilled Water, 944 parts, or	1 pint.
To make 1000 parts, or . . . about	1 pint.

Dissolve the Soda in the Distilled Water. The Soda used in this process should be of the full strength directed by the Pharmacopœia (90 per cent.). Soda of any other strength, however, may be used, if a proportionately larger or smaller quantity be taken, the proper amount for the above formula being ascertained by dividing 5000 by the percentage of absolute Soda (hydrate of sodium) contained therein. Solution of Soda should be kept in well-stopped bottles.

The sodium hydrate is obtained in this process by decomposing the carbonate by heating it in contact with an aqueous mixture of calcium hydrate: calcium carbonate is formed, and sodium hydrate remains in solution.

$$\underset{\text{Sodium Carbonate.}}{Na_2CO_3} + \underset{\text{Calcium Hydrate.}}{Ca(HO)_2} = \underset{\text{Sodium Hydrate.}}{2NaHO} + \underset{\text{Calcium Carbonate.}}{CaCO_3}.$$

Liquor Sodæ. *U. S.*	Odor, Taste, and Reaction.	Solubility.
A clear, colorless liquid. When dropped into a concentrated solution of tartaric acid, no precipitate is produced (difference from solution of potassa). Sp. gr. 1.059.	Odorless; very acrid and caustic taste; strongly alkaline reaction.	Freely miscible with water and alcohol.

Test for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
A drop taken up by a platinum loop and held in a non-luminous flame imparts to it an intense yellow color.	Carbonate.	When dropped into an acid, it should produce no effervescence, or, at most, only a slight escape of isolated bubbles.
	Alkaline Earths.	When neutralized by nitric acid, the Solution should not yield more than a faint cloudiness with test-solution of carbonate of sodium.
To neutralize 20 Gm. of Solution of Soda should require 25 C.c. of the volumetric solution of oxalic acid.	Sulphate.	When neutralized by nitric acid, the Solution should not yield more than a faint cloudiness with test-solution of chloride of barium.
	Chloride.	When neutralized by nitric acid, the Solution should not yield more than a faint cloudiness with test-solution of nitrate of silver, with a little nitric acid.
	Foreign Impurities.	The neutralized Solution, when evaporated to dryness, should yield a residue which is dissolved by water without leaving more than a small quantity of insoluble matter.

Uses.—Solution of soda is an antacid, and is used for the same purposes and in the same dose as solution of potassa (see p. 447).

SODII ACETAS. *U. S.* Acetate of Sodium.

$NaC_2H_3O_2.3H_2O$; 136.

Preparation.—This salt is obtained on the large scale in the process for making acetic acid. For medicinal purposes it may be made conveniently by saturating acetic acid with sodium carbonate, filtering the solution, concentrating it, and obtaining the salt in crystals.

$$\underset{\text{Acetic Acid.}}{2HC_2H_3O_2} + \underset{\text{Sodium Carbonate.}}{Na_2CO_3} = \underset{\text{Sodium Acetate.}}{2NaC_2H_3O_2} + \underset{\text{Water.}}{H_2O} + \underset{\text{Carbon Dioxide.}}{CO_2}$$

It is sometimes granulated, and in this form it is more convenient for dispensing purposes than the usual large crystals.

Sodii Acetas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Large, colorless, transparent, monoclinic prisms, efflorescent in dry air. When heated, the salt melts, and on further heating loses all its water (39.7 per cent.), and falls into a white powder. At a higher temperature this powder again melts, and at red heat it is decomposed with the evolution of empyreumatic, inflammable vapors, leaving a blackened residue of an alkaline reaction, which imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass.	Odorless; saline, bitter taste; neutral or faintly alkaline reaction.	Cold. 3 parts. Boiling. 1 part.	Cold. 30 parts. Boiling. 2 parts.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
On adding sulphuric acid to a concentrated solution of the salt, and heating, vapor of acetic acid is evolved. A solution of the salt is rendered deep red by ferric chloride, and, on boiling, a red precipitate is formed. If 3.4 Gm. of Acetate of Sodium be ignited until gases cease to be evolved, the alkaline residue should require for complete neutralization 25 C.c. of the volumetric solution of oxalic acid (corresponding to 100 per cent. of pure Acetate of Sodium).	Chloride.	A 2 per cent. aqueous solution of the salt, acidulated with acetic acid, should yield no precipitate, or at most only a faint opalescence, on the addition of test-solution of nitrate of silver.
	Sulphate.	A 2 per cent. aqueous solution of the salt, acidulated with acetic acid, should yield no precipitate, or at most only a faint opalescence, on the addition of test-solution of chloride of barium.
	Silica.	If a solution of the salt, acidulated with nitric acid, is evaporated to dryness, the residue should be completely soluble in water.
	Metals.	A solution of the salt, acidulated with nitric acid, should remain unaffected by hydrosulphuric acid or sulphide of ammonium.
	Alkaline Earths.	A solution of the salt, acidulated with nitric acid, should yield no precipitate, or at most only a trace, on the addition of test-solution of carbonate of sodium.
	Carbonate.	Fragments of the salt, added to acetic acid, should produce no effervescence.
	Organic Impurities.	Fragments of the salt, when sprinkled upon colorless, concentrated sulphuric acid, should not impart to it any color.

Uses.—Sodium acetate is often preferred to potassium acetate as a diuretic. It is not deliquescent like the latter, and is said to be as efficient, although milder in its action. The dose is from twenty to sixty grains.

SODII ARSENIAS. *U.S.* Arseniate of Sodium.

$Na_2HAsO_4.7H_2O$; 311.9.

Preparation.—A process for this salt was formerly officinal: it is as follows:

Take of Arsenious Acid, in fine powder, 960 *grains;* Nitrate of Sodium, in fine powder, 816 *grains;* Dried Carbonate of Sodium, in fine powder, 528 *grains;* Distilled Water, boiling hot, *half a pint.* Having mixed the powders thoroughly, put the mixture into a large clay crucible, and cover it with the lid. Expose it to a full red heat until effervescence has ceased, and complete fusion has taken place. Pour the fused salt on a porcelain slab, and, as soon as it has solidified, and while it is still warm, put it into the hot water, and stir until it is dissolved. Filter the solution, and set it aside to crystallize. Drain the crystals, and, having dried them rapidly on filtering paper, keep them in a well-stopped bottle.

The rationale of this process is that when arsenious acid, sodium nitrate, and sodium carbonate are fused together, sodium pyroarseniate is formed, whilst nitrous anhydride and carbon dioxide escape as gases.

$$\underset{\text{Arsenious Acid.}}{As_2O_3} + \underset{\text{Sodium Nitrate.}}{2NaNO_3} + \underset{\text{Sodium Carbonate.}}{Na_2CO_3} = \underset{\text{Sodium Pyroarseniate.}}{Na_4As_2O_7} + \underset{\text{Nitrous Anhydride.}}{N_2O_3} + \underset{\text{Carbon Dioxide.}}{CO_2}$$

Sodium pyroarseniate is converted into the orthoarseniate (the officinal salt) by dissolving the former in water, filtering the solution, and crystallizing.

$$\underset{\text{Sodium Pyroarseniate.}}{Na_4As_2O_7} + \underset{\text{Water.}}{15H_2O} = 2(\underset{\text{Sodium Orthoarseniate.}}{Na_2HAsO_4,7H_2O}).$$

Sodii Arsenias. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, transparent, prismatic crystals, slightly efflorescent in dry air. When gently heated, the salt loses 28.8 per cent. of its weight (water of crystallization), and, if further heated to near 148° C. (298.4° F.), it loses the remainder of its water (11.5 per cent.).	Odorless; mild, feebly alkaline taste; faintly alkaline reaction.	Cold. 4 parts. Boiling. Very soluble.	Cold. Very slightly soluble. Boiling. 60 parts.

Tests for Identity.	Impurities.	Test for Impurities.
A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. The aqueous solution of the salt yields a white precipitate with test-solutions of chloride of barium, chloride of calcium, or sulphate of zinc, and a brick-red precipitate with test-solution of nitrate of silver, all of which precipitates are soluble in nitric acid.	Arsenite.	The cold aqueous solution of the salt, acidulated with hydrochloric acid, should not at once produce a yellow precipitate or assume a yellow color on the addition of solution of hydrosulphuric acid.

Uses.—The only advantage in using this salt in preference to arsenious acid is that the practitioner is more apt to get it of uniform quality: their properties are identical. The dose is from one-twelfth to one-third of a grain.

SODII BENZOAS. *U. S.* Benzoate of Sodium.

$NaC_7H_5O_2.H_2O$; 162.

Preparation.—Benzoic acid is added to a hot concentrated solution of pure sodium carbonate until effervescence ceases. The solution is evaporated, cooled, and allowed to crystallize, or, preferably, evaporated to dryness and granulated.

$$\underset{\text{Benzoic Acid.}}{2HC_7H_5O_2} + \underset{\text{Sodium Carbonate.}}{Na_2CO_3} = \underset{\text{Sodium Benzoate.}}{2NaC_7H_5O_2} + \underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O}.$$

The yield of granulated salt is about one and one-third times the quantity of benzoic acid used.

Sodii Benzoas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, semi-crystalline or amorphous powder, efflorescent on exposure to air. When heated, the salt melts, emits vapors having the odor of benzoic acid, then chars, and finally leaves a blackened residue of an alkaline reaction, which imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass.	Odorless, or having a faint odor of benzoin; sweetly astringent taste, free from bitterness; neutral reaction.	Cold. 1.8 parts. Boiling. 1.3 parts.	Cold. 45 parts. Boiling. 20 parts.

Test for Identity.	Test for Impurities.
On mixing an aqueous solution of the salt with a dilute solution of ferric sulphate, a flesh-colored precipitate is produced.	If the benzoic acid be separated from the salt by precipitating it with diluted nitric acid, and thoroughly washed, it should respond to the tests of purity mentioned under Acidum Benzoicum.

Uses.—Sodium benzoate has been prescribed as a remedy in phthisis, diphtheria, and similar complaints, in sixty-grain doses. It is employed also in rheumatism.

SODII BICARBONAS. *U. S.* Bicarbonate of Sodium.

$NaHCO_3$; 84.

Preparation.—This is not the ordinary "Bicarbonate of Soda:" the officinal requirement of this is that it shall contain 99 per cent. of bicarbonate of sodium. In order to attain this high grade, it is necessary to purify the commercial salt. This may be done by the process formerly officinal:

Take of Commercial Bicarbonate of Sodium, in powder, 64 oz. av.; Distilled Water, 6 pints. Introduce the powder into a suitable conical glass percolator, cover it with a piece of wet muslin, and pour the Water gradually upon it. When the liquid has ceased to drop, or when the washings cease to precipitate a solution of Sulphate of Magnesium, remove the Bicarbonate of Sodium from the percolator, and dry it on bibulous paper, in a warm place.

This purification amounts to nothing more than washing the salt with distilled water. The common impurities, sodium carbonate, chloride, and sulphate, and ammonium salts, are much more soluble than the bicarbonate, and they are easily dissolved out, without any serious loss of the bicarbonate. Alcohol is sometimes substituted for water for dissolving the carbonate.

Sodii Bicarbonas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, opaque powder, permanent in the air. When heated to about 70° C. (158° F.), the salt begins to lose moisture and carbonic acid gas, and, on continued heating, loses about 37 per cent. in weight. At a red heat the anhydrous residue melts, and a fragment of the salt imparts an intense yellow color to a non-luminous flame.	Odorless; cooling, mildly saline taste; slightly alkaline reaction.	Cold. 12 parts. Boiling. Decomposed.	Insoluble.

Test for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution, on being heated, disengages carbonic acid, and finally contains carbonate of sodium.	Chloride.	A 1 per cent. solution of the salt, supersaturated with nitric acid, should yield at most only a slight opalescence with test-solution of nitrate of silver.
	Sulphate.	A 1 per cent. solution of the salt, supersaturated with nitric acid, should yield only a slight opalescence with test-solution of chloride of barium.
To neutralize 4.2 Gm. of Bicarbonate of Sodium should require not less than 49.5 C.c. of the volumetric solution of oxalic acid (corresponding to at least 99 per cent. of Bicarbonate of Sodium).	Ammonium Salts.	On heating a small quantity of the salt with solution of soda, no ammoniacal vapor should be given off.
	More than about 3 per cent. of Carbonate.	If 2 Gm. of the salt be dissolved, with very gentle agitation, in 30 C.c. of cold water, and the solution added to a cold solution of 0.3 Gm. of mercuric chloride in 6 C.c. of water, only a white cloud, but neither a red precipitate nor a red color, should make its appearance within three minutes.

Uses.—If *officinal* bicarbonate of sodium were universally used, the preparations into which the commercial article now enters would be largely deprived of the disagreeable, bitter taste which is caused by the presence of carbonate. The dose and uses of the purified salt are about the same as those of the commercial.

SODII BICARBONAS VENALIS. *U. S.* Commercial Bicarbonate of Sodium.

$NaHCO_3$; 84.

Preparation.—All the processes for making this important salt of sodium, with one exception, consist in the addition of carbon dioxide to sodium carbonate. This operation cannot be carried on profitably upon the small scale: hence it is most advantageous for the pharmacist to buy commercial sodium bicarbonate and purify it for dispensing purposes (see page 475). Sodium carbonate contains ten molecules of water of crystallization; sodium bicarbonate contains none: hence provision must be made for the escape of this water, which is thrown out of combination during the process of carbonating. The

crystallized sodium carbonate is placed upon false bottoms in chambers arranged so that the water can escape as it is liberated.

$$\underset{\text{Sodium Carbonate.}}{Na_2CO_3} + \underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O} = \underset{\text{Sodium Bicarbonate.}}{2HNaCO_3}.$$

Sodium bicarbonate is also prepared by the ammonia-soda process, or *Solvay's*, as it is usually called. In this, carbon dioxide is passed into a solution of common salt in ammonia water, double decomposition ensues, sodium bicarbonate is precipitated, and ammonium chloride, being very soluble, remains in solution.

$$\underset{\text{Sodium Chloride.}}{NaCl} + \underset{\text{Ammonia.}}{NH_3} + \underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O} = \underset{\text{Sodium Bicarbonate.}}{HNaCO_3} + \underset{\text{Ammonium Chloride.}}{NH_4Cl}.$$

Sodii Bicarbonas Venalis. *U. S.*	Impurities.	Tests for Impurities.
See Sodii Bicarbonas. To neutralize 4.2 Gm. of the salt should require not less than 47.5 C.c. of the volumetric solution of oxalic acid (corresponding to at least 95 per cent. of Bicarbonate of Sodium).	Chloride.	A 1 per cent. aqueous solution of the salt, acidulated with nitric acid, should not yield an immediate precipitate with test-solution of nitrate of silver.
	Sulphate.	A 1 per cent. aqueous solution of the salt, acidulated with nitric acid, should not yield an immediate precipitate with test-solution of chloride of barium.
	Carbonate.	If a portion of the salt be agitated with a quantity of water insufficient to dissolve it, the cold filtrate should not yield more than a slight precipitate with a concentrated solution of sulphate of magnesium.

Uses.—Commercial "bicarbonate of soda" is largely used as an antacid in doses of ten to fifteen grains. It is preferably administered in carbonic acid water, and the draught is popularly known as "extra soda." The misnomer is caused by the erroneous use of the term "soda water."

SODII BISULPHIS. *U. S.* Bisulphite of Sodium.

$NaHSO_3$; 104.

Preparation.—The acid sodium sulphite is used in solution in the arts, but, owing to its unstable character, it is inferior to the normal sulphite. It is prepared by passing sulphurous acid gas into a solution of sodium carbonate until saturation takes place and all the carbon dioxide is expelled: the liquid is then evaporated, and the crystals which form on cooling are washed and dried.

$$\underset{\text{Sodium Carbonate.}}{Na_2CO_3} + \underset{\text{Sulphurous Acid.}}{2H_2SO_3} = \underset{\text{Sodium Bisulphite.}}{2NaHSO_3} + \underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O}.$$

It is converted by exposure to the air into sulphate and carbonate. It is largely manufactured for use in the arts as an *antichlor*, to neutralize the effects of the chlorine used in bleaching fabrics.

Sodii Bisulphis. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Opaque, prismatic crystals, or a crystalline or granular powder, slowly oxidized and losing sulphurous acid on exposure to air. When strongly heated, the salt decrepitates and is converted into sulphur and sulphate of sodium. A small fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass.	Faint sulphurous odor; disagreeable, sulphurous taste; acid reaction.	Cold. 4 parts. Boiling. 2 parts.	Cold. 72 parts. Boiling. 49 parts.

Test for Identity and Quantitative Test.	Impurities.	Test for Impurities.
On adding hydrochloric acid to an aqueous solution of the salt, sulphurous vapors are evolved, and the solution does not become cloudy (difference from hyposulphite). If 0.26 Gm. of the salt be dissolved in 10 C.c. of water, and a little gelatinized starch added, at least 45 C.c. of the volumetric solution of iodine should be required before a permanent blue tint appears after stirring (corresponding to at least 90 per cent. of pure Bisulphite of Sodium).	Sulphate.	A 1 per cent. aqueous solution of the salt, acidulated with hydrochloric acid, should not yield more than a faint cloudiness with test-solution of chloride of barium.

Uses.—Bisulphite of sodium is used as an antiseptic and antiferment, in doses of five to ten grains. The sulphite, however, is usually preferred.

SODII BORAS. *U. S.* Borate of Sodium.

$Na_2B_4O_7.10H_2O$; 382.

Preparation.—This salt is found in immense quantities in California as a crystalline deposit in the blue mud of an offset of Clear Lake. It is probable that this will continue to be the principal source of borax for many years to come. The process of purification consists simply in picking the large and perfect crystals out, washing them, and lixiviating the earth, which is strongly impregnated with borax, evaporating the solution, and crystallizing. It is sometimes called *biborate of sodium.*

Borax is found native in Thibet, Persia, and other localities. It is sometimes called *tincal.* Crude boric acid, obtained from Tuscany, is fused with dried sodium carbonate, and a hot solution of the residue is crystallized in order to produce borax.

Sodii Boras. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Colorless, transparent, shining, monoclinic prisms, slightly efflorescent in dry air. When heated, the powdered salt begins to lose water, then melts, on further heating swells up and forms a white, porous mass, which, at a red heat, fuses to a colorless glass, with complete loss of water of crystallization (47.1 per cent.).	Odorless; mild, cooling, sweetish, afterwards somewhat alkaline taste; alkaline reaction.	Cold. 16 parts. Boiling. 0.5 part.	Insoluble.	At 80° C. (176° F.) it is soluble in 1 part of glycerin.

Tests for Identity.	Impurities.	Tests for Impurities.
A fragment of the salt imparts an intense yellow color to a non-luminous flame. The saturated aqueous solution, on the addition of sulphuric acid, deposits shining crystalline scales, which impart a green color to the flame of alcohol.	Carbonate.	The aqueous solution should not effervesce with acids.
	Alkaline Earths.	The aqueous solution should not be precipitated nor be rendered cloudy by test-solution of carbonate of sodium.
	Metals.	The aqueous solution should not be affected by hydrosulphuric acid.
	Sulphate.	A 1 per cent. solution, strongly acidulated with nitric acid, should not be rendered turbid by the addition of a few drops of test-solution of chloride of barium.
	Chloride.	A 1 per cent. solution, strongly acidulated with nitric acid, should not be rendered turbid by the addition of a few drops of test-solution of nitrate of silver.

Uses.—Borax, as it is almost universally called, is antacid and diuretic. It enters into many mouth-washes, and is frequently applied in the form of powder to ulcers in the mouth, for which purpose it is admirably adapted, being mildly alkaline and not very soluble. Pharmaceutically, it is frequently used in small quantity to whiten ointments, particularly the ointment of rose-water. It is used for this purpose by dissolving it in water, and incorporating the solution.

SODII BROMIDUM. *U. S.* Bromide of Sodium.

NaBr; 102.8.

Preparation.—The process most used in making this salt is by decomposing ferrous bromide by treating it with sodium carbonate. The ferrous bromide is made by acting on iron wire with bromine in the presence of water, and, after filtering the solution, adding solution of sodium carbonate. The reaction may be thus expressed:

$$\underset{\text{Ferrous Bromide.}}{FeBr_2} + \underset{\text{Sodium Carbonate.}}{Na_2CO_3} = \underset{\text{Sodium Bromide.}}{2NaBr} + \underset{\text{Ferrous Carbonate.}}{FeCO_3}.$$

Sodium bromide may also be made by first producing ammonium bromide by treating a solution of ammonia with bromine (see Ammonii Bromidum), and then by double decomposition with sodium carbonate, forming sodium bromide and ammonium carbonate. The solution, by careful evaporation and granulation, may be made to yield sodium bromide, whilst ammonium carbonate, being composed of volatile compounds, is dissipated by the amount of heat used to granulate the sodium salt.

Sodii Bromidum. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Small, colorless or white, monoclinic crystals, or a crystalline powder, permanent in dry air. When heated to a dull red heat, the salt melts without losing weight. At a full red heat it is slowly volatilized without decomposition. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass.	Odorless; saline, slightly bitter taste; neutral or faintly alkaline reaction.	Cold. 1.2 parts. Boiling. 0.5 part.	Cold. 13 parts. Boiling. 11 parts.

Test for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
If disulphide of carbon be poured into a solution of the salt, then chlorine water added drop by drop, and the whole agitated, the disulphide will acquire a yellow or yellowish-brown color without a violet tint. 1 Gm. of the salt, when completely precipitated by nitrate of silver, yields, if perfectly pure, 1.824 Gm. of dry bromide of silver.	Bromate.	If diluted sulphuric acid be dropped on a portion of the salt, the latter should not at once assume a yellow color.
	Iodide.	If 1 Gm. of the salt be dissolved in 10 C.c. of water, some gelatinized starch added, and then a few drops of chlorine water be carefully poured on top, no blue zone should make its appearance at the line of contact of the two liquids.
	Sulphate.	On adding to 1 Gm. of the salt, dissolved in 20 C.c. of water, 5 or 6 drops of test-solution of nitrate of barium, no immediate cloudiness or precipitate should make its appearance.
	More than 3 per cent. of Chloride.	If 3 Gm. of the well-dried salt be dissolved in distilled water to 100 C.c., and 10 C.c. of this solution be treated with a few drops of test-solution of bichromate of potassium, and then volumetric solution of nitrate of silver be added, not more than 29.8 C.c. of the latter should be consumed before the red color ceases to disappear on stirring.

Uses.—Bromide of sodium is used for the same purposes as bromide of potassium. It is probably inferior to the latter as a nervous sedative, although frequently combined with it. The dose is thirty to sixty grains.

SODII CARBONAS. *U.S.* Carbonate of Sodium.

$Na_2CO_3.10H_2O$; 286.

Preparation.—Impure sodium carbonate, or soda-ash, is consumed in enormous quantities in the arts, and cheap methods of production have been long sought for. The process elaborated by Leblanc in 1784, a French apothecary, has been most largely used, and it possesses a historic interest because of the public endorsements which it received from the French government in 1794. It is remarkable that this process has been successfully worked, without material modifications, *for a century*, and has supplied the world with cheap soap and cheap glass. It also furnishes a striking illustration of the unrequited labors of inventors and benefactors, from the fact that Leblanc died a pauper in a French asylum. Sodium carbonate is made from common salt by two steps: first, by converting the salt by sulphuric acid into sodium sulphate, and, secondly, by decomposing the sulphate by calcium carbonate and charcoal at a high temperature, so as to yield sodium carbonate. The chemical reactions are as follows:

$$\underset{\text{Sodium Chloride.}}{2NaCl} + \underset{\text{Sulphuric Acid}}{H_2SO_4} = \underset{\text{Sodium Sulphate.}}{Na_2SO_4} + \underset{\text{Hydrochloric Acid.}}{2HCl},$$

$$\underset{\text{Sodium Sulphate.}}{Na_2SO_4} + \underset{\text{Calcium Carbonate.}}{CaCO_3} + \underset{\text{Carbon.}}{C_4} = \underset{\text{Sodium Carbonate.}}{Na_2CO_3} + \underset{\text{Calcium Sulphide.}}{CaS} + \underset{\text{Carbon Monoxide.}}{4CO}.$$

The sulphate, first dried, is mixed with its own weight of ground limestone, and half its weight of small coal, ground and sifted, and the whole is heated in a reverberatory furnace, where it fuses and forms a black mass. The coal, at the temperature employed, converts the sodium sulphate into sodium sulphide. This reacts with the limestone, so as to

form calcium sulphide and sodium carbonate. The black mass is next digested in warm water, which takes up the alkali and other soluble matters, and leaves the insoluble impurities, called *soda waste*, largely utilized in the manufacture of sodium hyposulphite. The solution is evaporated to dryness, and the mass obtained is calcined with one-fourth of its weight of sawdust, to convert the alkali fully into carbonate, by means of the carbonic acid resulting from the combustion of the sawdust. The product is redissolved in water, and the solution evaporated to dryness. This soda-ash contains about 50 per cent. of sodium carbonate.

Solvay's process for making sodium bicarbonate is given on page 477; the bicarbonate is easily converted into carbonate by heating, and the carbon dioxide is utilized in another part of the process.

The cryolite process is used largely in the United States. Cryolite, $Al_2F_6 + 6NaF$, consists mainly of a double fluoride of aluminium and sodium, containing in 100 parts 13 of aluminium, 34 of sodium, and 53 of fluorine. Sodium carbonate is obtained by heating cryolite with chalk, whereby calcium fluoride is formed, while the sodium and aluminium combine to form sodium aluminate, a weak salt, which is dissolved out by lixiviation. The soda is converted into carbonate by passing carbon dioxide under pressure through the solution; and the alumina, separated from the soda, becomes insoluble, and is deposited.

$$\underset{\text{Cryolite.}}{Al_2F_6} + 6NaF + \underset{\text{Calcium Carbonate.}}{6CaCO_3} = \underset{\text{Sodium Aluminate.}}{Al_2O_3,3Na_2O} + \underset{\text{Calcium Fluoride.}}{6CaF_2} + \underset{\text{Carbon Dioxide.}}{6CO_2}.$$

Sodii Carbonas. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Large, colorless, monoclinic crystals, rapidly efflorescing in dry air and falling into a white powder. When heated to about 35° C. (95° F.), the salt melts; on further heating, all the water (62.9 per cent.) gradually escapes, and at a red heat the anhydrous residue fuses. A fragment of the salt imparts an intense yellow color to a non-luminous flame.	Odorless; sharp, alkaline taste; alkaline reaction.	Cold. 1.6 parts. Boiling. 0.25 part.	Insoluble.	Soluble in 0.09 part of water at 38° C. (100.4° F.).

Test for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution strongly effervesces on the addition of an acid. To neutralize 7.15 Gm. of Carbonate of Sodium should require not less than 49 C.c. of the volumetric solution of oxalic acid (corresponding to at least 98 per cent. of pure, crystallized Carbonate of Sodium).	Chloride.	The aqueous solution of the salt should be free from suspended or colored impurities, and, after being supersaturated with nitric acid, should not yield more than a trifling precipitate with test-solution of nitrate of silver.
	Sulphate.	The aqueous solution of the salt should be free from suspended or colored impurities, and, after being supersaturated with nitric acid, should not yield more than a trifling precipitate with test-solution of chloride of barium.
	Metals.	The aqueous solution of the salt should remain unaffected by hydrosulphuric acid, either before or after being supersaturated with hydrochloric acid.
	Alumina.	A solution of the salt acidified by the last-named acid, when supersaturated with ammonia and boiled, should not yield a gelatinous precipitate.

Uses.—Sodium carbonate is one of the most useful of the alkaline salts: it is the source of most of the sodium salts made by the pharmacist. It is important in this connection not to use the effloresced carbonate, as it is stronger in proportion to the amount of water that it has lost. It is rarely given internally, on account of its disagreeable taste. The dose is from ten to twenty grains.

SODII CARBONAS EXSICCATUS. *U.S.* **Dried Carbonate of Sodium.**

Carbonate of Sodium, 200 parts, or	**32 oz. av.**
To make 100 parts, or	**16 oz. av.**

Break the salt into small fragments, allow it to effloresce by exposure to warm air for several days, then expose it to a temperature of about 45° C. (113° F.), until it has been converted into a white powder weighing *one hundred parts* [or 16 oz. av.]. Pass the powder through a sieve, and preserve it in well-stopped bottles.

The theoretical proportion of water in officinal sodium carbonate is nearly 63 per cent., so that the exsiccated carbonate still retains some water of crystallization. It is a white, hygroscopic powder, corresponding to the tests of purity under Sodii Carbonas. It is, of course, twice the strength of sodium carbonate. To neutralize 2.65 Gm. of Dried Carbonate of Sodium should require not less than 36.3 C.c. of the volumetric solution of oxalic acid (corresponding to at least 72.6 per cent. of anhydrous carbonate of sodium).

Uses.—The object of driving off water from sodium carbonate is to furnish a more uniform product, and to render the dose, when administered in pill or powder form, less bulky. The dose is from five to ten grains.

SODII CHLORAS. *U.S.* **Chlorate of Sodium.**

$NaClO_3$; 106.4.

Preparation.—This salt is usually prepared by Wittstein's process, which consists in first preparing acid sodium tartrate by adding a strong solution containing nine and a half parts of tartaric acid to a hot aqueous solution of nine parts of sodium carbonate. The hot solution is mixed with one in which eight parts of potassium chlorate have been dissolved. Acid potassium tartrate separates, whilst sodium chlorate remains in solution. The filtered solution is evaporated and crystallized. If desired of absolute purity, it may be recrystallized from an alcoholic solution.

$$\underset{\text{Sodium Carbonate.}}{Na_2CO_3} + 2\underset{\text{Tartaric Acid.}}{H_2C_4H_4O_6} = 2\underset{\text{Acid Sodium Tartrate.}}{NaHC_4H_4O_6} + \underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O},$$

$$\underset{\text{Acid Sodium Tartrate.}}{NaHC_4H_4O_6} + \underset{\text{Potassium Chlorate.}}{KClO_3} = \underset{\text{Sodium Chlorate.}}{NaClO_3} + \underset{\text{Acid Potassium Tartrate.}}{KHC_4H_4O_6}.$$

Owing to the facility with which this salt parts with its oxygen, the following officinal cautionary direction should be borne in mind. Chlorate of Sodium should be kept in well-stopped bottles, and should not be triturated with readily oxidizable or combustible substances. Accidents have occurred from triturating it with sulphur, sugar, etc.

Sodii Chloras. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, transparent tetrahedrons of the regular system, permanent in dry air. When heated, the salt melts and afterwards gives off a portion of its oxygen, finally leaving a residue of a neutral reaction completely soluble in water.	Odorless; cooling, saline taste; neutral reaction.	Cold. 1.1 parts. Boiling. 0.5 part.	Cold. 40 parts. Boiling. 43 parts.

Tests for Identity.	Impurities.	Tests for Impurities.
A fragment of this residue imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass; and its aqueous solution, acidulated with nitric acid, yields, with test-solution of nitrate of silver, a white precipitate soluble in ammonia.	Potassium.	The aqueous solution of the salt should not produce a white, crystalline precipitate on the addition of a saturated solution of bitartrate of sodium.
	Sulphate.	A dilute aqueous solution of the salt should yield no precipitate with test-solution of chloride of barium.
	Calcium.	Nor with test-solution of oxalate of ammonium.
	Chloride.	And at most only a faint cloudiness with test-solution of nitrate of silver.

Uses.—This salt has an advantage over potassium chlorate in point of solubility, thus permitting the use of stronger solutions. The dose is from ten to twenty grains.

SODII CHLORIDUM. *U.S.* Chloride of Sodium.

NaCl; 58.4.

Preparation.—Common salt is universally distributed over the world, and may be mined, as rock salt, or obtained by evaporating sea-water.

Sodii Chloridum. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
White, shining, hard, cubical crystals, or a crystalline powder, permanent in the air. When heated, the salt decrepitates; at a red heat it melts, and at a still higher temperature it is slowly volatilized, with partial decomposition. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass.	Odorless; purely saline taste; neutral reaction.	Cold. 2.8 parts. Boiling. 2.5 parts.	Almost insoluble.

Test for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution, acidulated with nitric acid, yields, with test-solution of nitrate of silver, a white precipitate soluble in ammonia. 1 Gm. of Chloride of Sodium, when completely precipitated by nitrate of silver, should yield 2.450 Gm. of dry chloride of silver.	Alkaline Earths.	An aqueous solution of the salt should yield no precipitate or cloudiness on the addition of test-solution of carbonate of sodium.
	Sulphate.	Nor on the addition of test-solution of chloride of barium.
	Metals.	Nor on the addition of hydrosulphuric acid or sulphide of ammonium.
	Iodide or Bromide.	If 2 Gm. of the salt be digested with 20 Gm. of alcohol, the cold and filtered alcoholic solution evaporated to dryness, the residue dissolved in water, a little gelatinized starch added, and subsequently chlorine water, drop by drop, no colored tint should make its appearance at the line of contact of the two liquids.

Uses.—Chloride of sodium is largely used as a condiment and antiseptic. It undoubtedly serves a useful purpose in the animal economy, as many animals possess an instinctive craving for it. Salt baths are tonic, and valuable aids in many diseases. Common salt is used as a styptic in hemorrhage.

SODII HYPOPHOSPHIS. *U.S.* Hypophosphite of Sodium.

$NaH_2PO_2.H_2O$; 106.

Preparation.—This salt is prepared by mixing a solution of six ounces of calcium hypophosphite in four pints of water with a solution of ten ounces of sodium carbonate in one and a half pints of water.

$$Ca2H_2PO_2 + Na_2CO_3 = 2NaH_2PO_2 + CaCO_3.$$

Calcium Hypophosphite. Sodium Carbonate. Sodium Hypophosphite. Calcium Carbonate.

Double decomposition takes place, with the formation of calcium carbonate and sodium hypophosphite, of which the latter is held in solution, and the former precipitated. After filtration to separate the calcium carbonate, the solution is evaporated to a pellicle, and then stirred constantly till the salt granulates, the heat being continued. If required quite pure, the granulated salt is dissolved in officinal alcohol, and the liquid, having been evaporated to a syrupy consistence, is set aside to crystallize.

Sometimes the sodium hypophosphite explodes with violence during the evaporation of its solution. This was ascribed to the use of too high a heat; but the same accident has occurred when the heat was applied by means of a water-bath. Evaporation, therefore, should be performed below 100° C. (212° F.).

$$5NaH_2PO_2 = Na_4P_2O_7 + NaPO_3 + 2PH_3 + 2H_2.$$

Sodium Hypophosphite. Sodium Pyrophosphate. Sodium Metaphosphate. Phosphoretted Hydrogen. Hydrogen.

The gases evolved by heat are hydrogen and phosphoretted hydrogen. The latter is well known to be spontaneously inflammable.

The acid present in this salt is *hypophosphorous acid*. It consists of one atom of phosphorus, two atoms of oxygen, and three atoms of hydrogen, only one of the latter being replaceable by a metal.

This acid is a powerful deoxidizer: as it reduces mercury and silver from their combinations, it should not be prescribed with either. The solubility of sodium hypophosphite and of other hypophosphites is increased by the addition of hypophosphorous acid.

Sodii Hypophosphis. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Small, colorless or white, rectangular plates, or a white, granular powder, deliquescent on exposure to air. When heated in a dry test-tube, the salt loses water, then evolves a spontaneously inflammable gas (phosphoretted hydrogen) burning with a bright yellow flame. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass.	Odorless; sweetish, saline taste; neutral reaction.	Cold. 1 part. Boiling. 0.12 part.	Cold. 30 parts. Boiling. 1 part.

Tests for Identity.	Impurities.	Tests for Impurities.
On triturating or heating the salt with an oxidizing agent, the mixture will explode. The aqueous solution yields, with test-solution of nitrate of silver, a white precipitate, which rapidly turns brown and black; and, when acidulated with hydrochloric acid, and added to excess of test-solution of mercuric chloride, it first produces a white precipitate of calomel, and, on further addition, metallic mercury separates.	Carbonate.	The aqueous solution of the salt should not effervesce on the addition of an acid.
	Calcium.	The aqueous solution of the salt should not be precipitated nor be rendered cloudy by test-solution of oxalate of ammonium.
	Potassium.	The aqueous solution of the salt should not be precipitated nor be rendered cloudy by a saturated solution of bitartrate of sodium.
	Sulphate.	An aqueous solution of the salt, after being acidulated with hydrochloric acid, should not produce a white precipitate or cloudiness with test-solution of chloride of barium.
	Phosphate.	On mixing the aqueous solution with test-solution of magnesium, not more than a slight cloudiness should make its appearance.

Uses.—Sodium hypophosphite is used in exhausted conditions of the nervous system; in pharmacy, solely as an ingredient in syrup of the hypophosphites.

SODII HYPOSULPHIS. *U. S.* Hyposulphite of Sodium.

$Na_2S_2O_3.5H_2O$; 248.

Preparation.—Sodium hyposulphite, or, more correctly, *sodium thiosulphate*, is made by decomposing soluble calcium thiosulphate, obtained by the oxidation of alkali waste, with either sodium sulphate or sodium carbonate.

$$\underset{\text{Calcium Thiosulphate.}}{CaS_2O_3} + \underset{\text{Sodium Sulphate.}}{Na_2SO_4} = \underset{\text{Sodium Thiosulphate.}}{Na_2S_2O_3} + \underset{\text{Calcium Sulphate.}}{CaSO_4}.$$

Other methods of making "hyposulphite of soda" have been used, but the above process has superseded them because of its economy. It is now made on a very large scale.

Sodii Hyposulphis. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Large, colorless, transparent, monoclinic prisms or plates, efflorescent in dry air. When rapidly heated to about 50° C. (122° F.), the salt melts; when slowly heated until it is effloresced, and afterward to 100° C. (212° F.), it loses all its water (36.3 per cent.), and at a low red heat it is decomposed. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass.	Odorless; cooling, somewhat bitter and sulphurous taste; neutral or faintly alkaline reaction.	Cold. 1.5 parts. Boiling. 0.5 part, with partial decomposition.	Insoluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution dissolves chloride or oxide of silver, and discharges the color of solution of iodized starch and of solution of iodine. Sulphuric acid added to the solution gives rise to the odor of burning sulphur and causes a white precipitate of sulphur (difference from bisulphite and sulphite). A solution of 2 Gm. of the salt in 10 Gm. of water, agitated for a short time with 1 Gm. of iodine, should yield a colorless liquid, with at most only a faint white opalescence (corresponding to about 98 per cent. of pure Hyposulphite of Sodium).	Sulphate.	A solution of the salt in 80 parts of water should not be rendered cloudy by a few drops of test-solution of chloride of barium.
	Carbonate.	A concentrated solution of the salt should not effervesce when added to diluted acetic acid.

Uses.—This compound is used in the officinal volumetric test of hyposulphite of sodium, and occasionally in medicine, as an alterative and resolvent, in doses of ten to thirty grains. Externally, it is used in baths, and also as an ointment. Its principal use is in the arts, as an *antichlor* in paper-manufacture; whilst in photography, under the abbreviated name of "hypo," it is invaluable as a solvent for the unaltered silver chloride or bromide in the film.

SODII IODIDUM. *U. S.* Iodide of Sodium.

NaI; 149.6.

Preparation.—This iodide may be prepared by double decomposition between solutions of ferrous iodide and sodium carbonate, or by treating a solution of sodium hydrate with iodine, exactly as in the preparation of potassium iodide. The former process is preferable if working on a small scale.

$$\underset{\text{Ferrous Iodide.}}{FeI_2} + \underset{\text{Sodium Carbonate.}}{Na_2CO_3} = \underset{\text{Sodium Iodide.}}{2NaI} + \underset{\text{Ferrous Carbonate.}}{FeCO_3}.$$

By boiling the solution containing the ferrous carbonate the latter is rendered less bulky, and it can be easily separated by filtration.

Sodii Iodidum. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Minute, colorless or white, monoclinic crystals, or a crystalline powder, deliquescent on exposure to air. At a dull red heat the salt melts without losing weight. At a full red heat it is slowly volatilized, with partial decomposition. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass.	Odorless; saline and slightly bitter taste; neutral or faintly alkaline reaction.	Cold. 0.6 part. Boiling. 0.3 part.	Cold. 1.8 parts. Boiling. 1.4 parts.

Test for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
If disulphide of carbon be poured into a solution of the salt, then chlorine water added drop by drop, and the whole agitated, the disulphide of carbon will acquire a violet color. 1 Gm. of the powdered and dried salt, when completely precipitated by nitrate of silver, yields, if perfectly pure, 1.566 Gm. of dry iodide of silver.	Iodate.	The aqueous solution of the salt, mixed with gelatinized starch, and afterwards with diluted hydrochloric acid, should not at once acquire a blue color.
	More than about 0.5 per cent. of Chloride or Bromide.	If 1 Gm. of the salt be dissolved in 10 C.c. of water of ammonia, then shaken with a solution of 1.2 Gm. of nitrate of silver in 20 C.c. of water, and the filtrate be supersaturated with 7 C.c. of nitric acid, no cloudiness should make its appearance within ten minutes.
	Sulphate.	On adding to 1 Gm. of the salt, dissolved in 20 C.c. of water, 5 or 6 drops of test-solution of nitrate of barium, no immediate cloudiness or precipitate should make its appearance.

Uses.—Medicinally, this salt is preferred to potassium iodide by some practitioners, although apparently without good reasons. The dose is from five to fifteen grains.

SODII NITRAS. *U.S.* Nitrate of Sodium.

$NaNO_3$; 85.

Preparation.—Sodium nitrate, called also *cubic nitre*, and *Chili saltpetre*, is a native salt found in Chili and Peru, purified by crystallization from its aqueous solution. It is the cheapest source for obtaining nitrates, as explained elsewhere (see Acidum Nitricum).

Sodii Nitras. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, transparent, rhombohedral crystals, slightly deliquescent in damp air. When heated to about 312° C. (594° F.), the salt melts, and, on further heating, it is decomposed, giving off oxygen, and leaving a residue which emits nitrous vapors on the addition of sulphuric acid.	Odorless; cooling, saline, and slightly bitter taste; neutral reaction.	Cold. 1.3 parts. Boiling. 0.6 part.	Scarcely soluble. Boiling. 40 parts.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
Thrown upon red-hot coals, the salt deflagrates. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass.	Metals.	The aqueous solution of the salt should remain unaffected by hydrosulphuric acid or sulphide of ammonium.
	Alkaline Earths.	The aqueous solution of the salt should remain unaffected by carbonate of ammonium.
	Potassium.	The aqueous solution of the salt should remain unaffected by a saturated solution of bitartrate of sodium.
If 1 Gm. of Nitrate of Sodium be heated with 1 Gm. of concentrated sulphuric acid, and the mixture be kept at a red heat until it ceases to lose weight, the residue should weigh 0.835 Gm.	Sulphate.	An aqueous solution of the salt, previously acidulated with nitric acid, should yield no precipitate or cloudiness with test-solution of nitrate of barium.
	Chloride.	Similar solution of the salt should yield at most only a faint opalescence with test-solution of nitrate of silver.
	Iodide.	On adding to a solution of the salt a few drops of solution of hydrosulphuric acid, then some gelatinized starch, and carefully pouring a few drops of chlorine water on top, no blue zone should make its appearance at the line of contact of the two liquids.

Uses.—Sodium nitrate is used in a number of diseases, such as epilepsy, angina pectoris, dysentery, etc., but evidently without marked effects. The dose is fifteen to twenty grains.

SODII PHOSPHAS. *U.S.* Phosphate of Sodium.

$Na_2HPO_4.12H_2O$; 358.

Preparation.—Sodium phosphate may be prepared by the process formerly officinal, as follows:

Take of Bone, calcined to whiteness and in fine powder, 120 oz. troy; Sulphuric Acid 72 oz. troy; Carbonate of Sodium, Water, each, a sufficient quantity. Mix the powder with the Sulphuric Acid in an earthen vessel; then add 8 pints of Water, and, having stirred the mixture thoroughly, digest for three days, occasionally adding a little Water to replace that which is lost by evaporation, and frequently stirring the mixture. At the expiration of that time, pour in 8 pints of

boiling Water, and strain through muslin, gradually adding more boiling Water until the liquid passes nearly tasteless. Set by the strained liquor that the dregs may subside, and, having poured off the clear solution, boil it down to 8 pints. To the concentrated liquid, poured off from the newly formed dregs and heated in an iron vessel, add by degrees Carbonate of Sodium, previously dissolved in hot Water, until effervescence ceases, and the phosphoric acid is completely saturated; then filter the liquid, and set it aside to crystallize. Having removed the crystals, add, if necessary, a small quantity of Carbonate of Sodium to the liquid, so as to render it slightly alkaline; then alternately evaporate and crystallize, so long as crystals are produced. Lastly, keep the crystals in a well-stopped bottle.

The part of bones which is incombustible is obtained by burning them to whiteness, and consists of neutral calcium phosphate, called *bone-phosphate*, or *bone-ash*, associated with some calcium carbonate. When this is mixed with sulphuric acid, the calcium carbonate is entirely decomposed, giving rise to effervescence. The calcium phosphate undergoes partial decomposition; the greater part of the lime, being liberated, precipitates as calcium sulphate, while the phosphoric acid combines with the undecomposed portion of the phosphate, and remains in solution as an acid calcium phosphate, holding dissolved a small portion of calcium sulphate.

$$\underset{\text{Calcium Phosphate.}}{Ca_3 2PO_4} + \underset{\text{Sulphuric Acid.}}{2H_2SO_4} = \underset{\text{Acid Calcium Phosphate.}}{CaH_4 2PO_4} + \underset{\text{Calcium Sulphate.}}{2CaSO_4}.$$

In order to separate the acid phosphate from the precipitated mass of calcium sulphate, boiling water is added to the mixture, the whole is strained, and the sulphate washed as long as acid phosphate is removed, which is known by the water passing through in an acid state. The different liquids which have passed the strainer, consisting of the solution of acid calcium phosphate, are mixed and allowed to stand; and by cooling a portion of calcium sulphate is deposited, which is got rid of by decantation. The bulk of the liquid is now reduced by evaporation, and, in consequence of the diminution of the water, a fresh portion of calcium sulphate is deposited, which is separated by subsidence and decantation as before. The acid calcium phosphate solution, being heated, is now saturated by means of a hot solution of sodium carbonate. The carbonic acid is liberated with effervescence, and the alkali, combining with the excess of acid of the acid phosphate, produces sodium phosphate; while the acid calcium phosphate, by the loss of its excess of acid, becomes the neutral phosphate and precipitates.

$$\underset{\text{Acid Calcium Phosphate.}}{CaH_4 2PO_4} + \underset{\text{Sodium Carbonate.}}{Na_2CO_3} = \underset{\text{Calcium Phosphate.}}{CaHPO_4} + \underset{\text{Sodium Phosphate.}}{Na_2HPO_4} + \underset{\text{Water.}}{H_2O} + \underset{\text{Carbon Dioxide.}}{CO_2}.$$

The calcium phosphate is separated by filtration; and the filtered liquor, which is a solution of sodium phosphate, is evaporated so as to crystallize.

Sodii Phosphas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Large, colorless, transparent, monoclinic prisms, speedily effloresing and becoming opaque on exposure to air. When heated to about 40° C. (104° F.), the salt melts, yielding a clear liquid, and, on continued heating to near 100° C. (212° F.), it loses all its water of crystallization (60.3 per cent.).	Odorless; cooling, saline, and feebly alkaline taste; slightly alkaline reaction.	Cold. 6 parts. Boiling. 2 parts.	Insoluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. The aqueous solution of the salt yields, with test-solution of magnesium, a white, crystalline precipitate soluble in acids.	Carbonate.	The aqueous solution of the salt should not effervesce on the addition of an acid.
	Metals.	An aqueous solution of the salt, when acidified with hydrochloric acid, should remain unaffected by hydrosulphuric acid or sulphide of ammonium.
If 1 Gm. of Phosphate of Sodium be completely precipitated by test-mixture of magnesium, the washed, dried, and ignited precipitate should weigh 0.31 Gm.	Sulphate.	An aqueous solution of the salt, when acidified with nitric acid, should not yield more than a faint cloudiness with test-solution of nitrate of barium.
	Chloride.	An aqueous solution of the salt, when acidified with nitric acid, should not yield more than a faint cloudiness with test-solution of nitrate of silver.

Uses.—Sodium phosphate is principally used as a cathartic, in doses of half an ounce to one ounce.

SODII PYROPHOSPHAS. *U.S.* Pyrophosphate of Sodium.

$Na_4P_2O_7.10H_2O$; 446.

Preparation.—Sodium pyrophosphate, as its name would indicate, is prepared by heating sodium phosphate in a suitable vessel to redness. When sodium phosphate is subjected to a temperature of 44° C. (111.2° F.), it melts in its water of crystallization; if the heat be increased to 100° C. (212° F.), all the water is dispelled, and but 40 per cent. of the original weight remains; at 300° C. (572° F.) it is converted into the tetrabasic phosphate or pyrophosphate. By dissolving this residue in water, filtering, and crystallizing, the salt may be obtained.

Sodii Pyrophosphas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, translucent, monoclinic prisms, permanent in the air. When heated, the salt loses its water of crystallization (40.36 per cent.); at a higher temperature it fuses, and, on cooling, concretes to a crystalline mass.	Odorless; cooling, saline, and feebly alkaline taste; slightly alkaline reaction.	Cold. 12 parts. Boiling. 1.1 parts.	Insoluble.

Tests for Identity.	Impurities.	Tests for Impurities.
A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. Its aqueous solution yields, with excess of test-solution of nitrate of silver, a white precipitate and a neutral filtrate.	Carbonate.	The aqueous solution of the salt should not effervesce on the addition of an acid.
	Metals.	An aqueous solution of the salt, when acidified with hydrochloric acid, should remain unaffected by hydrosulphuric acid or sulphide of ammonium.
	Sulphate.	The aqueous solution of the salt, when acidified with nitric acid, should not yield more than a faint opalescence with test-solution of nitrate of barium.
	Chloride.	The aqueous solution of the salt, when acidified with nitric acid, should not yield more than a faint opalescence with test-solution of nitrate of silver.

Uses.—This salt was made officinal solely because of its use in preparing ferric pyrophosphate.

SODII SALICYLAS. *U. S.* Salicylate of Sodium.

$2NaC_7H_5O_3.H_2O$; 338.

Preparation.—Sodium salicylate is prepared by mixing one hundred parts of pure salicylic acid with sufficient distilled water to form a paste, and then with one hundred and four parts of pure crystallized carbonate of sodium (uneffloresced) in a glass or porcelain vessel; carbon dioxide will be evolved, and sodium salicylate will remain in solution.

$$\underset{\text{Salicylic Acid.}}{2HC_7H_5O_3} + \underset{\text{Sodium Carbonate.}}{Na_2CO_3} = \underset{\text{Sodium Salicylate.}}{2NaC_7H_5O_3} + \underset{\text{Water.}}{H_2O} + \underset{\text{Carbon Dioxide.}}{CO_2}$$

The liquid may be strained through thoroughly-washed muslin if found necessary, and heated in a capsule until the carbon dioxide is expelled.

It should not be filtered through ordinary paper, on account of the impurities generally present; the slightest contact with iron will discolor the product, and for this reason the commercial sodium carbonate is unfitted for use in making this salt.

If alkaline to litmus paper, enough salicylic acid must be added to be slightly in excess, and the solution should be evaporated at a low heat to dryness. If the acid is not in excess, the salt will not be white, but gray or lead-colored; and if heated too much, the odor of carbolic acid will be noticed.

Sodii Salicylas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Small, white, crystalline plates, or a crystalline powder, permanent in the air. When heated, the salt gives off inflammable vapors and leaves an alkaline residue amounting to between 30 and 31 per cent. of the original weight, which effervesces with acids, and imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass.	Odorless; sweetish, saline, and mildly alkaline taste; feebly acid reaction.	Cold. 1.5 parts. Boiling. Very soluble.	Cold. 6 parts. Boiling. Very soluble.

Tests for Identity.	Impurities.	Tests for Impurities.
On supersaturating the aqueous solution with sulphuric acid, a bulky white precipitate is obtained, which is soluble in boiling water, from which it crystallizes on cooling; also soluble in ether, and striking an intense violet color with ferric salts.	Carbonate.	The aqueous solution of the salt should be colorless, and should not effervesce on the addition of acids.
	Foreign Organic Matter.	Agitated with about 15 parts of concentrated sulphuric acid, the salt should not impart color to the acid within fifteen minutes.
	Sulphate.	If a solution of 1 Gm. of the salt in a mixture of 50 C.c. of alcohol and 25 C.c. of water be acidulated with nitric acid, the filtered solution should yield no precipitate, nor be rendered turbid on the addition of a few drops of test-solution of chloride of barium.
	Chloride.	If a solution of 1 Gm. of the salt in a mixture of 50 C.c. of alcohol and 25 C.c. of water be acidulated with nitric acid, the filtered solution should yield no precipitate, nor be rendered turbid on the addition of a few drops of test-solution of nitrate of silver.

Uses.—This salt is administered in rheumatic and neuralgic affections, in doses of twenty to thirty grains.

SODII SANTONINAS. *U. S.* Santoninate of Sodium.

$2NaC_{15}H_{19}O_4.7H_2O$; 698.

Preparation.—Sodium santoninate may be made by diluting four fluidounces of solution of soda with one fluidounce of water, adding one ounce (av.) of santonin, and heating with stirring until the latter is dissolved, filtering, and setting the solution aside to crystallize. By carefully evaporating the mother-liquors the yield of sodium santoninate may be at least one and a quarter ounces (av.).

Sodii Santoninas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, transparent, tabular, rhombic crystals, slowly colored yellow by exposure to light, slightly efflorescent in dry air. When heated to 100° C. (212° F.), until it ceases to lose weight, the salt loses 18 per cent. of its weight (water of crystallization). At a higher heat it chars and finally leaves an alkaline residue, which imparts an intense yellow color to a non-luminous flame.	Odorless; mildly saline and somewhat bitter taste; slightly alkaline reaction.	Cold. 3 parts. Boiling. 0.5 part.	Cold. 12 parts. Boiling. 3.4 parts.

Test for Identity.	Impurities.	Tests for Impurities.
The aqueous solution, on the addition of hydrochloric acid, deposits a crystalline precipitate which is soluble in chloroform, and which yields, with alcoholic solution of potassa, a scarlet-red liquid gradually becoming colorless.	Alkaline Earths.	A 5 per cent. aqueous solution of the salt should not be precipitated nor be rendered turbid by test-solution of carbonate of sodium.
	Alkaloids.	A 5 per cent. aqueous solution of the salt should not be precipitated nor be rendered turbid by picric or tannic acid.

Uses.—The only advantage claimed for this salt over santonin is its greater solubility, and this is a doubtful one, because as an anthelmintic

for lumbricoid worms, santonin is preferable; and there is an advantage in its insolubility,—*i.e.*, it is less bitter and less disagreeable to the taste. The dose is three grains.

SODII SULPHAS. *U. S.* Sulphate of Sodium.

$Na_2SO_4.10H_2O$; 322.

Preparation.—This salt is largely obtained as a by-product in the manufacture of soda-ash, hydrochloric and nitric acids, ammonium chloride, etc. It is often termed *Glauber's Salt.*

Sodii Sulphas. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Large, colorless, transparent, monoclinic prisms, rapidly effloresecing on exposure to air, and ultimately falling into a white powder; insoluble in alcohol. When heated to about 30° C. (86° F.), the salt melts, and, on further heating, gradually loses all its water (55.9 per cent.). At a red heat the anhydrous salt melts without decomposition.	Odorless; cooling, saline, and somewhat bitter taste; neutral reaction.	Cold. 2.8 parts. Boiling. 0.4 part.	Insoluble.	Soluble in 0.25 part of water at 33° C. (91.4° F.).

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. The aqueous solution yields, with test-solution of chloride of barium, a white precipitate insoluble in nitric acid. 1 Gm. of Sulphate of Sodium, when completely precipitated by chloride of barium, should yield 0.723 Gm. of dry sulphate of barium.	Carbonate.	The aqueous solution of the salt should not effervesce on the addition of an acid.
	Metals.	The aqueous solution of the salt should not be affected by hydrosulphuric acid or sulphide of ammonium.
	Chloride.	A dilute aqueous solution of the salt, acidulated with nitric acid, should yield no precipitate, or at most only a slight one, on the addition of test-solution of nitrate of silver.
	Ammonia.	A dilute aqueous solution of the salt, acidulated with nitric acid, should not give off alkaline vapors when heated with soda.

Care must be employed, in using the formulas requiring this salt, to see that it is not effloresced, as such a salt may have lost half of its water of crystallization, and be therefore twice as strong as it should be.

Uses.—This well-known sulphate is largely used in veterinary practice. As a purgative it is not so well suited for administration to human beings, the magnesium sulphate being preferred. It may be given to adults in doses of half an ounce to one ounce.

SODII SULPHIS. *U. S.* Sulphite of Sodium.

$Na_2SO_3.7H_2O$; 252.

Preparation.—A very satisfactory mode of making this sulphite is by dissolving a convenient weight of sodium carbonate in a small quan-

tity of water, then passing sulphurous acid gas through the solution until it is completely saturated and acid sodium sulphite is formed. The addition of an equal weight of sodium carbonate forms a solution of the neutral sulphite, which is to be evaporated and crystallized.

$$\underset{\text{Sodium Carbonate.}}{Na_2CO_3} + \underset{\text{Sulphurous Acid.}}{SO_2} = \underset{\text{Sodium Sulphite.}}{Na_2SO_3} + \underset{\text{Carbon Dioxide.}}{CO_2}.$$

The sodium sulphite which is most frequently used now is the *granulated sulphite of sodium:* this is prepared by evaporating a solution of the sulphite to dryness in the usual manner. As thus prepared, it is much more stable than the crystallized salt: it should be remembered, however, that it is nearly twice the strength of the latter, and the quantity used should be proportionally lessened. Theoretically, the quantity of water present in the crystals is exactly half their weight.

Sodii Sulphis. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, transparent, monoclinic prisms, efflorescent in dry air. When gently heated, the salt melts, then loses its water (50 per cent.), and at a red heat it is decomposed and leaves a residue having an alkaline reaction. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass.	Odorless; cooling, saline and sulphurous taste; neutral or feebly alkaline reaction.	Cold. 4 parts. Boiling. 0.9 part.	Sparingly soluble.

Test for Identity and Quantitative Test.	Impurities.	Test for Impurities.
Addition of diluted hydrochloric acid to the aqueous solution gives rise to the odor of burning sulphur, and the solution does not become cloudy (difference from hyposulphite). If 0.63 Gm. of the salt be dissolved in 25 C.c. of water, and a little gelatinized starch added, at least 45 C.c. of the volumetric solution of iodine should be required before a permanent blue tint appears after stirring (corresponding to at least 90 per cent. of pure Sulphite of Sodium).	Sulphate.	A 1 per cent. aqueous solution of the salt, strongly acidulated with hydrochloric acid, should yield no precipitate, or at most only a white cloudiness, on the addition of a few drops of test-solution of chloride of barium.

Uses.—Sodium sulphite is one of the most useful antiferments. It is given in doses of ten to thirty grains.

SODII SULPHOCARBOLAS. *U.S.* Sulphocarbolate of Sodium.

$NaC_6H_5SO_4.2H_2O$; 232.

Preparation.—Sodium sulphocarbolate may be made by mixing equal parts of pure carbolic acid and strong sulphuric acid, whereby *sulphocarbolic acid*, $C_6H_5HSO_4$, is produced. The mixed liquids must be subjected to a temperature of 55° C. (131° F.) for several days, and then twenty parts of water should be added. Two parts of barium carbonate are mixed with the liquid, a little at a time, carefully graduating the quantity until effervescence ceases. The liquid is now allowed to stand, to permit the precipitation of the barium sulphate, and of any

carbonate which may be present, and the liquor filtered. The solution of *barium sulphocarbolate* is decomposed by adding sodium carbonate until precipitation ceases, when the liquid is filtered from the barium carbonate, and the sodium sulphocarbolate may be obtained by evaporating the filtrate and crystallizing.

$$\underset{\text{Carbolic Acid.}}{C_6H_5HO} + \underset{\text{Sulphuric Acid.}}{H_2SO_4} = \underset{\text{Sulphocarbolic Acid.}}{HC_6H_5SO_4} + \underset{\text{Water.}}{H_2O}.$$

Sodii Sulphocarbolas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, transparent, rhombic prisms, permanent in the air. When heated, the salt loses its water and becomes a white powder. At a higher temperature it emits inflammable vapors having the odor of carbolic acid, and leaves a residue amounting to 36 per cent. of the original weight, the filtered solution of which, acidulated with nitric acid, produces a white precipitate with test-solution of chloride of barium.	Odorless, or nearly so; cooling, saline, somewhat bitter taste; neutral reaction.	Cold. 5 parts. Boiling. 0.7 part.	Cold. 132 parts. Boiling. 10 parts.

Tests for Identity.	Impurities.	Test for Impurities.
A fragment of the salt imparts an intense yellow color to a non-luminous flame. The dilute aqueous solution of the salt is colored violet by test-solution of ferric chloride.	Sulphate.	A 1 per cent. aqueous solution of the salt should not at once be rendered turbid nor be precipitated by test-solution of chloride of barium.

Uses.—This salt is used as an antiferment, in doses of ten to twenty grains. It is also used in injections.

CHAPTER XL.

THE LITHIUM SALTS.

THE lithium salts resemble those of potassium and sodium. The metal lithium is comparatively rare, for, although widely distributed in nature, it occurs in such small quantities that the necessary labor to extract it makes it expensive: it is found in *triphyline*, in *spodumene*, and in many mineral waters.

Lithium is a metal resembling potassium and sodium, although much less prone to oxidation: it is soft, *and is the lightest of all known metals*, having the specific gravity of 0.5891. Heated in the air, lithium ignites at a temperature above its fusing point, burning with a bright white light; when thrown on water, it oxidizes, but does not fuse like sodium. Chemically, lithium is a monad, like sodium and potassium.

Tests for Lithium Salts.

1. A colorless flame is colored a vivid red by volatile salts of lithium.
2. Concentrated solutions of lithium salts yield a white precipitate with ammonium carbonate; no precipitate is produced in dilute solution or if ammonia salts are present.
3. Sodium phosphate produces a white precipitate in alkaline or neutral solution, which is soluble in acids and in solutions of ammonia salts.

Officinal Preparations of Lithium.

Officinal Name.	Preparation.
Inorganic Radicals.	
Lithii Bromidum	By decomposing ferrous bromide with lithium carbonate.
Lithii Carbonas	By precipitating lithium sulphate with ammonium carbonate.
Organic Radicals.	
Lithii Benzoas	By treating lithium carbonate with benzoic acid.
Lithii Citras	By treating lithium carbonate with citric acid.
Lithii Salicylas	By treating lithium carbonate with salicylic acid.

Unofficinal Preparations of Lithium.

Lithii Borocitras. Borocitrate of Lithium.	Dissolve 20 p. citric acid, 4 p. lithium carbonate, and 6 p. boric acid in sufficient boiling water, evaporate carefully to dryness, and reduce to a powder.
Lithii Chloridum, $LiCl$, = 42.4. Chloride of Lithium.	Dissolve lithium carbonate in hydrochloric acid, and concentrate to crystallize.
Lithii Diborocitras. Diborocitrate of Lithium.	Dissolve 20 p. citric acid, 7 p. lithium carbonate, and 12 p. boric acid in sufficient boiling water, evaporate carefully to dryness, and reduce to a powder.
Lithii Iodidum, LiI, = 133.6. Iodide of Lithium.	Digest a solution of calcium iodide with lithium carbonate in slight excess, filter, and evaporate to dryness.
Lithii Nitras, $LiNO_3$, = 69. Nitrate of Lithium.	Dissolve lithium carbonate in nitric acid, filter, and concentrate to crystallize.
Lithii Phosphas, Li_3PO_4, = 164. Phosphate of Lithium.	Add a solution of lithium carbonate to a solution of sodium phosphate with caustic soda, a crystalline powder will be precipitated.
Lithii Sulphas, $Li_2SO_4.H_2O$, = 128. Sulphate of Lithium.	Dissolve lithium carbonate in sulphuric acid, filter, and concentrate to crystallize.

LITHII BENZOAS. *U.S.* Benzoate of Lithium.

$LiC_7H_5O_2$; 128.

Preparation.—This may be made by Shuttleworth's process, which is as follows:

One ounce (av.) of lithium carbonate is put in a capsule with nine fluidounces of water, the mixture is heated, and three and a quarter ounces (av.) of benzoic acid in small portions added, until the carbonate is all decomposed and effervescence ceases: the solution is filtered and evaporated to dryness, or crystallized if desired. The yield is three and a half ounces. The advantage of this process is a saving in time and labor in evaporating.

$$\underset{\text{Lithium Carbonate.}}{Li_2CO_3} + \underset{\text{Benzoic Acid.}}{2HC_7H_5O_2} = \underset{\text{Lithium Benzoate.}}{2LiC_7H_5O_2} + \underset{\text{Water.}}{H_2O} + \underset{\text{Carbon Dioxide.}}{CO_2}.$$

Lithii Benzoas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white powder, or small, shining scales, permanent in the air. When heated, the salt fuses; at a higher temperature it chars, emits inflammable vapors having a benzoin-like odor, and finally leaves a black residue of an alkaline reaction, and imparting a crimson color to a non-luminous flame.	Odorless, or having a faintly benzoin-like odor; cooling and sweetish taste; faintly acid reaction.	Cold. 4 parts. Boiling. 2.5 parts.	Cold. 12 parts. Boiling. 10 parts.

Tests for Identity.	Impurities.	Tests for Impurities.
On mixing the aqueous solution with a dilute solution of ferric sulphate, a flesh-colored precipitate is produced. If the benzoic acid be separated from the salt by precipitation with diluted nitric acid, and thoroughly washed, it should respond to the tests of purity mentioned under Acidum Benzoicum.	Salts of Alkalies.	On dissolving the residue, left on ignition, in diluted hydrochloric acid, and evaporating the filtered solution to dryness, 1 part of the residue should be completely soluble in 3 parts of absolute alcohol, which, when ignited, should burn with a crimson flame, and the addition of an equal volume of stronger ether to the alcoholic solution should produce no precipitate.
	Salts of Alkaline Earths.	On dissolving another portion of the residue left on ignition in a small quantity of water, the solution should produce no precipitate with test-solution of oxalate of ammonium.
	Metals.	The aqueous solution of the salt should remain unaffected by hydrosulphuric acid or sulphide of ammonium.

Uses.—Lithium benzoate is used as a remedy in gout and rheumatism, in doses of fifteen to twenty grains.

LITHII BROMIDUM. *U.S.* Bromide of Lithium.

LiBr; 86.8.

Preparation.—There are several methods for making this salt: 1. By dissolving lithium carbonate in hydrobromic acid. 2. By mixing solutions of lithium sulphate and potassium bromide. 3. By mixing lithium carbonate, bromine, and water together, and passing hydrosulphuric acid gas through the mixture. 4. By placing 300 grains of

iron and 2 fluidounces of water in a flask, and adding gradually 1 oz. av. of bromine, shaking with the application of moderate heat until the mixture has acquired a green color and lost the odor of bromine: the solution of ferrous bromide is then filtered, heated, and 200 grains of lithium carbonate are added. The solution is filtered, and evaporated until the salt granulates.

$$\underset{\text{Ferrous Bromide.}}{FeBr_2} + \underset{\text{Lithium Carbonate.}}{Li_2CO_3} = \underset{\text{Lithium Bromide.}}{2LiBr} + \underset{\text{Ferrous Carbonate.}}{FeCO_3}.$$

Lithii Bromidum. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, granular salt, very deliquescent. At a low red heat the salt fuses, and at a higher heat it is slowly volatilized. A fragment of the salt imparts a crimson color to a non-luminous flame.	Odorless; very sharp, somewhat bitter taste; neutral reaction.	Very soluble.	Very soluble.

Test for Identity.	Impurities.	Tests for Impurities.
If disulphide of carbon be poured into a solution of the salt, then chlorine water added drop by drop, and the whole agitated, the disulphide will acquire a yellow or yellowish-brown color without a violet tint.	Salts of Alkalies.	One part of the salt should be completely soluble in 3 parts of absolute alcohol, and the addition of an equal volume of stronger ether to the alcoholic solution should produce no precipitate.
	Salts of Alkaline Earths.	On dissolving a portion of the salt in a small quantity of water, the solution should produce no precipitate with test-solution of oxalate of ammonium.
	Metals.	The aqueous solution of the salt should remain unaffected by hydrosulphuric acid or sulphide of ammonium.

Uses.—Lithium bromide is probably the most efficient of all the bromides as a hypnotic. The dose is fifteen to thirty grains.

LITHII CARBONAS. *U.S.* Carbonate of Lithium.

Li_2CO_3; 74.

Preparation.—Lithium carbonate may be prepared from lepidolite, one of the minerals in which it is found, in the following manner: 10 parts of finely powdered lepidolite, 10 parts of barium carbonate, 5 parts of barium sulphate, and 3 parts of potassium sulphate are fused at a very high temperature in a wind furnace. The heavy silicate and barium sulphate sink to the bottom, and a layer of potassium and lithium sulphates is found at the top of the fused mass. These can be extracted by simple lixiviation, and then the carbonate prepared by double decomposition with ammonium carbonate.

Lithii Carbonas. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A light, white powder, permanent in the air. On heating a small quantity of the salt on a platinum loop in a non-luminous flame, it fuses to a clear, transparent bead, imparting a crimson color to the flame.	Odorless; alkaline taste; alkaline reaction.	Cold. 130 parts.	Cold. Insoluble. Boiling. 130 parts.	Soluble in acids, with copious effervescence.

Test for Impurities.
If a solution of the salt in diluted hydrochloric acid be evaporated to dryness, the residue should respond to the tests of purity mentioned, for the corresponding residue, under Lithii Benzoas.

Uses.—This salt is the source of the lithium salts, and it is prescribed in gout, in doses of five to fifteen grains.

LITHII CITRAS. *U. S.* Citrate of Lithium.

$Li_3C_6H_5O_7$; 210.

Preparation.—The process formerly officinal may be usefully employed in making this salt:

Take of Carbonate of Lithium 100 grains; Citric Acid, in crystals, 200 grains; Distilled Water 2 fl. oz. Dissolve the Citric Acid in the water gently heated, and to the solution gradually add the Carbonate of Lithium until perfectly dissolved, heating the solution so long as effervescence is produced. Evaporate, by means of a steam- or sand-bath, to a viscid consistence, dry the residue in an oven, at a temperature of about 240° F., then rapidly pulverize it, and preserve the powder in a well-stopped bottle.

$$\underset{\text{Lithium Carbonate.}}{3Li_2CO_3} + \underset{\text{Citric Acid.}}{2H_3C_6H_5O_7} = \underset{\text{Lithium Citrate.}}{2Li_3C_6H_5O_7} + \underset{\text{Water.}}{3H_2O} + \underset{\text{Carbon Dioxide.}}{3CO_2}.$$

Lithium citrate should be kept in well-stopped bottles.

Lithii Citras. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white powder, deliquescent on exposure to air. When exposed to a red heat, the salt chars, emits inflammable vapors, and finally leaves a black residue having an alkaline reaction, which imparts a crimson color to a non-luminous flame. The aqueous solution of the salt, mixed with test-solution of chloride of calcium, deposits a white precipitate on boiling.	Odorless; slightly cooling, faintly alkaline taste; neutral reaction.	Cold. 5.5 parts. Boiling. 2.5 parts.	Slightly soluble.

Test for Impurities.
On dissolving the residue, left on ignition, in diluted hydrochloric acid, and evaporating the filtered solution to dryness, the residue should respond to the tests of purity mentioned, for the corresponding residue, under Lithii Benzoas.

Uses.—Lithium citrate is used for the same purposes as lithium carbonate: it is more soluble than the latter. The dose is from fifteen to twenty grains.

LITHII SALICYLAS. *U. S.* Salicylate of Lithium.

$2LiC_7H_5O_3.H_2O$; 306.

Preparation.—This salt may be prepared by adding 60 grains of lithium carbonate to 1 fluidounce of distilled water and heating the mixture to boiling, then adding 220 grains of salicylic acid and continuing the heat until effervescence ceases, filtering, and evaporating.

$$\underset{\text{Lithium Carbonate.}}{Li_2CO_3} + \underset{\text{Salicylic Acid.}}{2HC_7H_5O_3} = \underset{\text{Lithium Salicylate.}}{2LiC_7H_5O_3} + \underset{\text{Water.}}{H_2O} + \underset{\text{Carbon Dioxide.}}{CO_2}$$

This salt should be kept in well-stopped bottles.

Lithii Salicylas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white powder, deliquescent on exposure to air. When strongly heated, the salt chars, emits inflammable vapors, and finally leaves a black residue having an alkaline reaction, and imparting a crimson color to a non-luminous flame.	Odorless, or nearly so; sweetish taste; faintly acid reaction.	Very soluble.	Very soluble.

Tests for Identity.	Impurities.	Tests for Impurities.
On supersaturating the dilute aqueous solution with hydrochloric acid, a bulky, white precipitate is obtained, which is soluble in boiling water, from which it crystallizes on cooling; also soluble in ether; and producing an intense violet color with ferric salts.	Carbonate.	The aqueous solution should be colorless, and should not effervesce on the addition of an acid.
	Foreign Organic Matters.	When agitated with 15 parts of concentrated sulphuric acid, the salt should not impart any color to the acid within fifteen minutes.
	Salts of Alkalies.	On dissolving the residue, left on ignition, in diluted hydrochloric acid, and evaporating the filtered solution to dryness, the residue should respond to the tests of purity mentioned, for the corresponding residue, under Lithii Benzoas.

Uses.—This salicylate is used, like sodium salicylate, for rheumatism and gout: it is given in doses of twenty to forty grains.

CHAPTER XLI.

AMMONIUM.

THE ammonium salts resemble those of the alkali metals so closely in their physical and chemical properties that they are appropriately considered in this place.

The metal ammonium has not yet been isolated in the free state, so that its appearance cannot be described. An *ammonium amalgam* is known, however, made by dissolving potassium in mercury and adding a strong solution of ammonium chloride to it. It is a spongy, metallic substance, which easily decomposes into ammonia, mercury, and hydrogen.

Tests for Ammonium Salts.

1. At high temperatures ammonium compounds are volatilized.

2. When heated with sodium, potassium, or calcium hydrate, the odor of ammonia is evolved: the latter restores the color of reddened litmus paper, and darkens the blue color of paper moistened with solution of copper sulphate. Ammonia forms a white cloud with vapor of hydrochloric acid.

3. Solution of platinic chloride, with a few drops of hydrochloric acid, if added to a solution of an ammonium salt, produces a yellow precipitate.

4. Ammonium salts are mostly colorless, and generally very soluble in water.

Officinal Preparations of Ammonium.

Officinal Name.	Composition and Preparation.
Aqua Ammoniæ	10 per cent. by weight aqueous solution of NH_3.
Aqua Ammoniæ Fortior	28 per cent. by weight aqueous solution of NH_3.
Spiritus Ammoniæ	10 per cent. by weight alcoholic solution of NH_3.
Spiritus Ammoniæ Aromaticus	An aromatic hydro-alcoholic solution of ammonium carbonate.
Linimentum Ammoniæ	30 p. water of ammonia; 70 p. cotton seed oil.
Liquor Ammoniæ Acetatis	Made by mixing solution of acetic acid and ammonium carbonate.
Ammonii Benzoas	By dissolving benzoic acid in water of ammonia.
Ammonii Bromidum	By adding water of ammonia gradually to bromine under water.
Ammonii Carbonas	By subliming a mixture of ammonium chloride and calcium carbonate.
Ammonii Chloridum	By subliming a mixture of ammonium sulphate and sodium chloride.
Ammonii Iodidum	By mixing solutions of potassium iodide and ammonium sulphate.
Ammonii Nitras	By treating ammonium carbonate with nitric acid.
Ammonii Phosphas	By mixing solutions of phosphoric acid and ammonia.
Ammonii Sulphas	By saturating gas liquor with sulphuric acid and crystallizing.
Ammonii Valerianas	By passing ammonia gas into monohydrated valerianic acid.
Trochisci Ammonii Chloridi	2 gr. ammonium chloride in each lozenge.

Unofficinal Preparations of Ammonium.

Ammonii Arsenias, $(NH_4)_2,H,AsO_4$, = 175.9. Arseniate of Ammonium.	Saturate a concentrated solution of arsenious acid with water of ammonia, and allow it to evaporate spontaneously.
Ammonii Bicarbonas, NH_4HCO_3, = 79. Bicarbonate of Ammonium.	Treat 1 p. powdered ammonium carbonate with 2 p. water, and decant the liquid, the residue being the bicarbonate.
Ammonii Bichromas, $(NH_4)_2Cr_2O_7$, = 252.8. Bichromate of Ammonium.	Add chromic acid to water of ammonia, and concentrate to crystallize.
Ammonii Boras, $2(NH_4HBr_2O_4).3H_2O$, = 264. Borate of Ammonium.	Dissolve 1 p. boric acid in 3 p. warm water of ammonia, sp. gr. 960, and allow to cool slowly.
Ammonii Carbonas Pyro-oleosus. Pyro-oleous Carbonate of Ammonium.	Incorporate thoroughly 32 p. ammonium carbonate with 1 p. ethereal animal oil.
Ammonii Citras, $(NH_4)_3C_6H_5O_7 + 3H_2O$, = 303. Citrate of Ammonium.	Dissolve 1 p. citric acid in water, add sufficient water of ammonia to neutralize, filter, and concentrate to crystallize.
Ammonii et Ferri Chloridum. Chloride of Ammonium and Iron.	Mix 32 p. ammonium chloride with 9 p. solution of ferric chloride, and evaporate to dryness with constant stirring.
Ammonii et Potassii Tartras. Tartrate of Ammonium and Potassium.	Add ammonium carbonate to a hot solution of acid potassium tartrate until neutralized, evaporate and crystallize.
Ammonii Formas, NH_4CHO_2, = 63. Formate of Ammonium.	Neutralize formic acid with water of ammonia, and evaporate to crystallize.
Ammonii Fluoridum, NH_4F, = 37. Fluoride of Ammonium.	Saturate hydrofluoric acid with water of ammonia.
Ammonii Nitris, NH_4NO_2, = 64. Nitrite of Ammonium.	Add a solution of ammonium chloride to one of silver nitrate, and evaporate the clear solution over sulphuric acid to dryness.
Ammonii Salicylas, $(NH_4)C_7H_5O_3$, = 155. Salicylate of Ammonium.	Neutralize salicylic acid with water of ammonia, and evaporate to crystallize.
Ammonii Sulphis, NH_4HSO_3, = 99. Sulphite of Ammonium.	Pass sulphurous acid into an alcoholic solution of ammonia, and collect the precipitate.
Ammonii Sulphocyanidum, NH_4CNS, = 76. Sulphocyanide of Ammonium.	Dissolve carbon bisulphide in alcohol, and heat in the presence of water of ammonia. Lastly, concentrate to crystallize.

AQUA AMMONIÆ. *U. S.* Water of Ammonia.

An aqueous solution of ammonia [NH_3; 17], containing 10 per cent., by weight, of the gas.

Preparation.—This useful liquid is rarely prepared by the pharmacist, for the reason that it can be made more economically by the manufacturer. The officinal process of 1870 (see U. S. Dispensatory, 15th edition, p. 226) directed that it should be made by mixing ammonium chloride, in small pieces, with milk of lime, and placing the mixture in a retort, connected with a cooled receiver by means of a glass tube, the end of which was dipped beneath the surface of distilled water contained in the receiver. The rationale of this process is that the lime is converted into chloride of calcium, whilst the ammoniacal gas, liberated by the heat, is dissolved in the distilled water.

$$\underset{\text{Ammonium Chloride.}}{2NH_4Cl} + \underset{\text{Calcium Hydrate.}}{Ca2HO} = \underset{\text{Ammonia.}}{2NH_3} + \underset{\text{Calcium Chloride.}}{CaCl_2} + \underset{\text{Water.}}{2H_2O}.$$

The manufacturer rarely uses ammonium chloride: the sulphate is cheaper, and it is frequently employed instead. But upon the large scale the ammoniacal liquor obtained from gas-works is used directly as the source, being mixed with milk of lime and heated; the gaseous ammonia is then passed through a series of tubes filled with charcoal, which retain the empyreumatic products. If the tubes are long enough,

and sufficient charcoal is employed, a pure product is assured; but much of the commercial water of ammonia is empyreumatic through defective purification.

Aqua Ammoniæ. *U.S.*	Odor, Taste, and Reaction.	Solubility.
A colorless, transparent liquid. It is completely volatilized by the heat of a water-bath. Sp. gr. 0.959.	Very pungent odor; acrid, alkaline taste; strongly alkaline reaction.	Miscible in all proportions with water and alcohol.

Test for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
On bringing a glass rod dipped into hydrochloric acid near the liquid, dense white fumes are evolved. To neutralize 8.5 Gm. (or 8.9 C.c.) of Water of Ammonia should require 50 C.c. of the volumetric solution of oxalic acid.	Empyreuma.	On supersaturating Water of Ammonia with diluted sulphuric acid, no empyreumatic odor should be developed.
	Traces of Carbonic Acid.	Water of Ammonia should remain clear or be at most only faintly clouded when mixed with 5 times its volume of lime-water.
	Sulphate.	When Water of Ammonia is supersaturated with nitric acid, the liquid should remain clear on the addition of test-solution of chloride of barium.
	Chloride.	When Water of Ammonia is supersaturated with nitric acid, the liquid should remain clear on the addition of test-solution of nitrate of silver.
	Metallic Impurities.	Either before or after neutralizing Water of Ammonia with nitric acid, it should not be affected by hydrosulphuric acid.
	Calcium.	Test-solution of oxalate of ammonium should produce no cloudiness with water of ammonia.

Uses.—Pharmaceutically, water of ammonia is frequently used to precipitate iron salts by combining with the acid radicals, ferric hydrate being thrown down. Its advantage over the fixed alkalies consists in its volatility, any excess being readily detected by the odor. It is largely used for cleaning fabrics, although the strength technically known as "Aqua Ammoniæ F. F. F.," or "20° Ammonia," is employed most frequently in the arts; the latter may be diluted with water, according to the formula given on page 82, if it is desirable to make officinal water of ammonia from it. In round numbers, three parts of 20° water of ammonia requires two parts of water to reduce it to the strength of officinal water of ammonia. Water of ammonia is rarely used internally, the aromatic spirit being preferred. The dose is ten to twenty minims, largely diluted. Externally, it is caustic and stimulating.

AQUA AMMONIÆ FORTIOR. *U.S.* Stronger Water of Ammonia.

An aqueous solution of Ammonia [NH_3; 17], containing 28 per cent., by weight, of the gas.

Preparation.—Stronger water of ammonia is prepared in the same way that water of ammonia is, the only difference between the two solutions being that of relative strength.

Description and Tests.—It is officinally described as a colorless, transparent liquid, of an excessively pungent odor, a very acrid and alkaline taste, and a strongly alkaline reaction. Specific gravity, 0.900 at 15° C. (59° F.). Its reactions for identity and purity are the same

as those of Aqua Ammoniæ. To neutralize 3.4 Gm. (or 3.9 C.c.) of Stronger Water of Ammonia should require 56 C.c. of the volumetric solution of oxalic acid.

Stronger water of ammonia should be kept in strong, glass-stoppered bottles, not completely filled, in a cool place.

Uses.—This liquid is used externally as a caustic and vesicant. It is too strong for internal administration.

SPIRITUS AMMONIÆ. *U.S.* Spirit of Ammonia.

An alcoholic solution of ammonia [NH_3; 17], containing 10 per cent., by weight, of the gas.

	By measure.
Stronger Water of Ammonia, 45 parts, or	8 fl. oz.
Alcohol, recently distilled, and which has been kept in glass vessels, a sufficient quantity,	
To make about	16 fl. oz.

Pour the Stronger Water of Ammonia into a flask connected with a well-cooled receiver, into which *eighty parts* [or 1 pint] of Alcohol are introduced. Heat the flask carefully, and very gradually, to a temperature not exceeding 60° C. (140° F.), and maintain it at that temperature for about ten minutes. Then disconnect the receiver, and, having ascertained the ammoniacal strength of the contents by means of the volumetric solution of oxalic acid, add enough Alcohol to make the product contain *ten per cent.* of Ammonia. Keep the product in glass-stoppered bottles, in a cool place.

This is an alcoholic solution of ammonia gas, of exactly the same strength as water of ammonia. The object of selecting a stronger aqueous solution of the same gas, to furnish the active ingredient, was to obtain an accurate and uniform quantity of the latter conveniently and without contamination. Practically, considerable difficulty will be experienced in maintaining the temperature of 60° C. (140° F.) for ten minutes. The amount of ammonia present is determined by a volumetric assay, in which 8.5 Gm. of the spirit of ammonia, diluted with distilled water, should require, for complete neutralization, 50 C.c. of the volumetric solution of oxalic acid. When diluted with water it should respond to the tests and reactions for Water of Ammonia. Sp. gr. 0.810.

Uses.—Spirit of ammonia is antacid and stimulant. It is not used internally to any extent, the aromatic spirit of ammonia being preferred. The dose is from ten to twenty minims, largely diluted with water.

SPIRITUS AMMONIÆ AROMATICUS. *U.S.* Aromatic Spirit of Ammonia.

	By measure.
Carbonate of Ammonium, 40 parts, or	500 grains.
Water of Ammonia, 100 parts, or	22 fl. dr.
Oil of Lemon, 12 parts, or	2½ fl. dr.
Oil of Lavender Flowers, 1 part, or	12 minims.
Oil of Pimenta, 1 part, or	10 minims.
Alcohol, recently distilled, and which has been kept in glass vessels, 700 parts, or	22 fl. oz.
Distilled Water, a sufficient quantity,	
To make 1000 parts, or	2 pints.

To the Water of Ammonia, contained in a flask, add *one hundred and forty parts* [or 4 fl. oz.] of Distilled Water, and afterward the Carbonate of Ammonium reduced to a moderately fine powder. Close the flask and agitate the contents until the Carbonate is dissolved. Weigh the Alcohol in a tared flask of suitable capacity, or pour twenty-two fluidounces in a bottle, add the oils, and then gradually add the solution of Carbonate of Ammonium, and afterward enough Distilled Water to make the product weigh *one thousand parts* [or measure 2 pints]. Lastly, filter the liquid, through paper, in a well-covered funnel.

Keep the product in glass-stoppered bottles, in a cool place.

This preparation acquires a dark color by keeping, although nearly colorless when freshly prepared. The discoloration is due to the action of the alkali upon the alcohol and volatile oils, more particularly the oil of pimenta. It should have the specific gravity of 0.885. As ordinarily prepared, from unselected ammonium carbonate, precipitation is very apt to take place: this is due to the use of exposed and effloresced ammonium carbonate, which contains more than the proper quantity of bicarbonate (see Ammonii Carbonas). The addition of water of ammonia in the formula is to convert the bicarbonate into the carbonate, the latter being soluble in the mixture of water and alcohol, whilst the bicarbonate is insoluble in alcohol. The ammonium carbonate should be carefully selected, and only the translucent pieces used.

Uses.—This is a very valuable and largely used antacid and stimulant: the dose is from twenty to sixty minims, largely diluted with water.

LIQUOR AMMONII ACETATIS. *U. S.* **Solution of Acetate of Ammonium.**
[SPIRIT OF MINDERERUS.]

	By measure.
Diluted Acetic Acid, 100 parts, or	1 pint.
Carbonate of Ammonium, a sufficient quantity.	

Add a sufficient quantity of Carbonate of Ammonium gradually to the Diluted Acetic Acid, until it is neutralized. This preparation should be freshly made when required for use.

Solution of Acetate of Ammonium may also be prepared in the following manner:

	By measure.
Carbonate of Ammonium, 10 parts, or	2 oz. av.
Acetic Acid, 28 parts, or	4¾ fl. oz.
Distilled Water, 142 parts, or	about 27 fl. oz.

Dissolve the Carbonate of Ammonium in *eighty parts* [or 1 pint] of Distilled Water, and filter the solution. To the Acetic Acid add *sixty-two parts* [or sufficient to make 1 pint] of Distilled Water. Keep the solutions in separate, well-stopped bottles, and, when Solution of Acetate of Ammonium is to be dispensed, weigh (or, if the alternative formula is used, measure) equal quantities of each solution and mix them.

The reaction involved in this process depends upon the decomposition of the ammonium carbonate with acetic acid: the free carbonic acid is a desirable addition to the solution, which should be dispensed with a moderate amount in solution.

$$\underset{\text{Acid Ammonium Carbonate and Carbamate.}}{(NH_4HCO_3)NH_4NH_2CO_2} + \underset{\text{Acetic Acid.}}{3HC_2H_3O_2} = \underset{\text{Ammonium Acetate.}}{3NH_4C_2H_3O_2} + \underset{\text{Carbon Dioxide.}}{2CO_2} + \underset{\text{Water.}}{H_2O}.$$

It will be found in practice that the second officinal formula is much more satisfactory than the first. The solutions keep well, and it is very convenient to mix them at the time of dispensing, and thus always be enabled to send out a fresh preparation, which retains sufficient carbonic acid gas to be grateful to the patient.

Liquor Ammonii Acetatis. *U. S.*	Taste and Reaction.	Solubility.
A clear, colorless liquid, free from empyreuma. It is wholly volatilized by heat.	Mildly saline taste; neutral or slightly acid reaction.	Freely miscible with water and alcohol.

Tests for Identity and Quantitative Test.	Impurities.	Test for Impurities.
When heated with potassa, it evolves vapor of ammonia, and, when heated with sulphuric acid, it gives out vapor of acetic acid. It contains about 7.6 per cent. of acetate of ammonium.	Metals.	It should not be darkened by hydrosulphuric acid or sulphide of ammonium.

Uses.—This solution is used as a diaphoretic or diuretic, in the dose of half a fluidounce.

AMMONII BENZOAS. *U.S.* Benzoate of Ammonium.

$NH_4C_7H_5O_2$; 139.

Preparation.—This salt may be advantageously prepared by the former officinal process, which is as follows:

Take of Benzoic Acid 2 oz. troy; Water of Ammonia 3½ fl. oz., or a sufficient quantity; Distilled Water 4 fl. oz. Dissolve the Acid in 3½ fl. oz. of the Water of Ammonia, previously mixed with the Distilled Water; evaporate with a gentle heat, occasionally adding Water of Ammonia, if necessary, to maintain a slight excess of the alkali; then set aside to crystallize, and dry the crystals without heat.

The process is one of direct combination, the reaction being as follows:

$$\underset{\text{Benzoic Acid.}}{HC_7H_5O_2} + \underset{\text{Water of Ammonia.}}{NH_4HO} = \underset{\text{Ammonium Benzoate.}}{NH_4C_7H_5O_2} + \underset{\text{Water.}}{H_2O}.$$

The object of retaining an excess of alkali in the process is to prevent the formation of the acid benzoate, which is less soluble than the officinal salt. The acid benzoate is frequently sold commercially as "benzoate of sodium."

Ammonii Benzoas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
This, white, four-sided, laminar crystals, permanent in the air. When strongly heated, the salt melts, emits vapors having the odor of ammonia and of benzoic acid, and is finally wholly dissipated.	Slight odor of benzoic acid; saline, bitter, afterwards slightly acrid taste; neutral reaction.	Cold. 5 parts. Boiling. 1.2 parts.	Cold. 28 parts. Boiling. 7.6 parts.

The officinal tests for identity and purity are as follows:

The aqueous solution of the salt, when heated with potassa, evolves ammonia. On mixing the aqueous solution with a dilute solution of ferric sulphate, a flesh-colored precipitate is thrown down. If the benzoic acid be separated from the salt by precipitating with diluted nitric acid, and thoroughly washed, it should answer to the reactions of purity mentioned under Acidum Benzoicum.

Uses.—Ammonium benzoate is used as a stimulant diuretic, in doses of five to twenty grains.

AMMONII BROMIDUM. *U. S.* Bromide of Ammonium.

NH_4Br; 97.8.

Preparation.—Several methods have been employed in making this salt: 1. By double decomposition between solutions of ammonium sulphate and potassium bromide, alcohol being added to separate the ammonium bromide. 2. By adding water of ammonia to a solution of ferrous bromide. 3. By Pile's process, in which one pound of bromine is poured carefully into four times its weight of distilled water in a stone jar, adding *very gradually*, a fluidounce at a time, about one quart of water of ammonia, covering the top of the jar with a glass plate when vapors arise, and, when all the ammonia has been added, and the solution is free from the smell of bromine, evaporating and granulating: the yield is about twenty ounces.

$$\underset{\text{Bromine.}}{6Br} + \underset{\text{Ammonia.}}{8NH_3} = \underset{\text{Ammonium Bromide.}}{6NH_4Br} + \underset{\text{Nitrogen.}}{N_2}.$$

Ammonii Bromidum. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, transparent, prismatic crystals, or a white, granular salt, becoming yellow on long exposure to air. Upon ignition the salt volatilizes completely without melting.	Odorless; pungent, saline taste; neutral reaction.	Cold. 1.5 parts. Boiling. 0.7 part.	Cold. 150 parts. Boiling. 15 parts.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution, when heated with potassa, evolves ammonia. If disulphide of carbon be poured into the solution, then chlorine water added drop by drop, and the whole agitated, the disulphide will acquire a yellow or yellowish-brown color without a violet tint. 1 Gm. of the powdered and dry salt, when completely precipitated by nitrate of silver, yields, if perfectly pure, 1.917 Gm. of dry bromide of silver.	Bromate.	If diluted sulphuric acid be dropped on the salt, the latter should not at once assume a yellow color.
	Iodide.	If 1 Gm. of the salt be dissolved in water, some gelatinized starch added, and then a few drops of chlorine water carefully poured on top, no blue zone should make its appearance at the line of contact of the two liquids.
	Sulphate.	On adding to 1 Gm. of the salt dissolved in 20 C.c. of water, 5 or 6 drops of test-solution of chloride of barium, no immediate cloudiness or precipitate should make its appearance.
	More than 3 per cent. of Chloride.	If 3 Gm. of the well-dried salt be dissolved in distilled water to 100 C.c., and 10 C.c. of this solution treated with a few drops of test-solution of bichromate of potassium, and then volumetric solution of nitrate of silver be added, not more than 31.4 C.c. of the latter should be consumed before the red color ceases to disappear on stirring.

Uses.—Bromide of ammonium is sometimes preferred to bromide of potassium as a hypnotic and sedative: it is asserted that it does not produce bromism. The dose is from ten to sixty grains.

AMMONII CARBONAS. *U. S.* Carbonate of Ammonium.

$NH_4HCO_3.NH_4NH_2CO_2$ or $N_3H_{11}C_2O_5$; 157.

Preparation.—The large consumption of this salt of ammonium has led to several methods of preparation. The one which is most used at present is the dry sublimation of ammonium chloride or ammonium sulphate with chalk or calcium carbonate: by double decomposition calcium chloride or calcium sulphate and ammonium carbonate are produced.

$$\underset{\text{Ammonium Chloride.}}{4NH_4Cl} + \underset{\text{Calcium Carbonate.}}{2CaCO_3} = \underset{\text{Ammonium Carbonate.}}{N_3H_{11}C_2O_5} + \underset{\text{Calcium Chloride.}}{2CaCl_2} + \underset{\text{Ammonia.}}{NH_3} + \underset{\text{Water.}}{H_2O}.$$

The advantage claimed for the use of ammonium sulphate is simply that of greater economy.

Officinal carbonate of ammonium is, chemically, a mixed salt. It consists of one molecule of acid ammonium carbonate or bicarbonate and one of ammonium *carbamate:* the latter may be regarded as ammonium carbonate minus a molecule of water. If ammonium carba mate is dissolved in water, it is soon changed to neutral ammonium carbonate.

$$\underset{\text{Ammonium Carbamate.}}{NH_4NH_2CO_2} + \underset{\text{Water.}}{H_2O} = \underset{\text{Neutral Ammonium Carbonate.}}{(NH_4)_2CO_3}.$$

Hence an aqueous solution of commercial ammonium carbonate contains both the neutral and acid carbonates. If the officinal ammonium carbonate is exposed to the air, it is soon changed into the acid carbonate or bicarbonate, through loss of ammonia, and it is thus depreciated in quality. The bicarbonate may be converted into the carbonate by treating it with water of ammonia. This fact is officinally recognized in the preparation of Aromatic Spirit of Ammonia, and *smelling salts* is frequently made by coarsely grinding ammonium carbonate, placing it in a bottle, and adding strong water of ammonia until it is saturated.

The principal impurity in the commercial salt is empyreuma, due to the presence of substances which communicate a disagreeable, charred odor and taste. The officinal test given below, of neutralizing the alkali and then proving the presence of empyreumatic substances by testing with potassium permanganate, is not as satisfactory as the physical test of the taste and odor of the solution after it has been neutralized.

Ammonii Carbonas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
White, translucent masses, consisting of Bicarbonate (Acid Carbonate) of Ammonium and Carbamate of Ammonium, losing both ammonia and carbonic acid gas on exposure to air, becoming opaque and finally converted into friable, porous lumps, or a white powder (Acid Carbonate of Ammonium).	Pungent, ammoniacal odor, free from empyreuma; sharp, saline taste; alkaline reaction.	4 parts at 15° C. (59° F.), and in 1.5 parts at 65° C. (149° F.).	Dissolves the carbamate and leaves the Acid Carbonate of Ammonium.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
When heated, the salt is wholly dissipated, without charring. If the aqueous solution is heated to near 47° C. (116.6° F.), it begins to lose carbonic acid gas, and at 88° C. (190.4° F.) it begins to give off vapor of ammonia. Dilute acids wholly dissolve the salt with effervescence. To neutralize 2.616 Gm. of Carbonate of Ammonium should require 50 C.c. of the volumetric solution of oxalic acid.	Sulphate.	On acidulating the aqueous solution of Carbonate of Ammonium with nitric acid, no turbidity should be produced by test-solution of chloride of barium.
	Chloride.	On acidulating the aqueous solution of Carbonate of Ammonium with nitric acid, no turbidity should be produced by test-solution of nitrate of silver.
	Metals.	On acidulating the aqueous solution of Carbonate of Ammonium with nitric acid, no turbidity should be produced by test-solution of hydrosulphuric acid.
	Empyreumatic substances.	If 1 Gm. of the salt be supersaturated with diluted sulphuric acid, then diluted to 20 C.c. with distilled water, and treated with a few drops of test-solution of permanganate of potassium, the color should not be perceptibly changed by standing for five minutes at the ordinary temperature.

Uses.—Ammonium carbonate is a stimulant in doses of three to five grains. It is generally administered in mucilaginous syrups. Pharmaceutically, it is employed in making the well-known solution of ammonium acetate, and in the aromatic spirit of ammonia, before mentioned.

AMMONII CHLORIDUM. *U. S.* Chloride of Ammonium.

NH_4Cl; 53.4.

Preparation.—Sal ammoniac, as it is termed commercially, is chiefly made from *gas liquor*, the ammoniacal liquid obtained from gas-works during the destructive distillation of the coal. The ammonia is generally neutralized with hydrochloric acid, the solution evaporated, and the dry mass sublimed in iron pots. The tough, fibrous sublimate is fitted for pharmaceutical and medicinal purposes by purification. It nearly always contains traces of iron, due to the reaction of a portion of the salt upon the cast-iron dome. This may be separated by treatment with water of ammonia, as shown in the following process of purification, formerly officinal:

Take of Chloride of Ammonium, in small pieces, 20 oz. troy; Water of Ammonia, 5 fl. dr.; Water, 2 pints. Dissolve the Chloride of Ammonium in the Water, in a porcelain dish, with the aid of heat; add the Water of Ammonia, and continue the heat for a short time; filter the solution while hot, and evaporate to dryness, with constant stirring, at a moderate heat, until it granulates: the ferrous chloride is converted into insoluble ferric hydrate, through the combination of the hydrochloric acid with water of ammonia.

Ammonii Chloridum. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A snow-white, crystalline powder, permanent in the air. On ignition, the salt volatilizes, without charring and without leaving a residue.	Odorless; cooling, saline taste; slightly acid reaction.	Cold. 3 parts. Boiling. 1.37 parts.	Very sparingly.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution of the salt, when heated with potassa, evolves vapor of ammonia. Test-solution of nitrate of silver, added to the aqueous solution previously acidulated with nitric acid, produces a white precipitate soluble in ammonia.	Barium.	The aqueous solution of the salt should remain unaffected by diluted sulphuric acid.
	Metals.	The aqueous solution of the salt should remain unaffected by hydrosulphuric acid or sulphide of ammonium.
	Sulphate.	After an aqueous solution of the salt has been acidulated with hydrochloric acid, it should not be rendered turbid by test-solution of nitrate of barium.
	Iron.	A 1 per cent. aqueous solution should not be rendered blue by test-solution of ferrocyanide of potassium.

Uses.—Ammonium chloride is a stimulant, and largely used as an addition to expectorant remedies, in doses of five to ten grains. It is sometimes used as an inhalation in catarrh, by drawing the vapors of hydrochloric acid and ammonia into a bottle, where they combine to form ammonium chloride in very fine powder.

AMMONII IODIDUM. *U.S.* Iodide of Ammonium.

NH_4I; 144.6.

Preparation.—This salt may be made by a modification of a former officinal process, as follows:

Take of Iodide of Potassium, in coarse powder, 4 oz. troy; Sulphate of Ammonium, in coarse powder, 867 grains; Boiling Distilled Water 2 fl. oz.; Alcohol, Water, each, a sufficient quantity. Mix the salts, add them to the Boiling Water, stir well, and allow the mixture to cool; then add a fluidounce of Alcohol, mix well, and reduce the temperature, by a bath of iced water, to about 40° F.; throw the mixture into a cool glass funnel, stopped with moistened cotton, and, when the clear solution has passed, pour upon the salt a fluidounce of a mixture containing two parts of Water and one part of Alcohol. Lastly, evaporate the solution rapidly to dryness, stirring constantly; and preserve the residue in a well-stopped bottle.

In this process double decomposition takes place, ammonium iodide and potassium sulphate being produced.

$$\underset{\text{Potassium Iodide.}}{2KI} + \underset{\text{Ammonium Sulphate.}}{(NH_4)_2SO_4} = \underset{\text{Ammonium Iodide.}}{2NH_4I} + \underset{\text{Potassium Sulphate.}}{K_2SO_4}.$$

The object of cooling the mixture and adding alcohol is to cause as much of the potassium sulphate to separate as possible, potassium sulphate being almost insoluble in alcohol.

Ammonii Iodidum. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, granular salt, or minute crystalline cubes, very deliquescent, and soon becoming yellow or yellowish-brown on exposure to air. When heated on platinum foil, the salt evolves vapor of iodine, and volatilizes without melting.	Odorless when white, but emitting a slight odor of iodine when colored; sharp, saline taste; neutral reaction.	Cold. 1 part. Boiling. 0.5 part.	Cold. 9 parts. Boiling. 3.7 parts.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution of the salt, when heated with potassa, evolves vapor of ammonia. If disulphide of carbon be poured into the solution, then chlorine water added drop by drop, and the whole agitated, the disulphide will acquire a violet color. 1 Gm. of the dried salt, when completely precipitated with nitrate of silver, yields, if perfectly pure, 1.62 Gm. of dry iodide of silver.	Sulphate.	On adding to 1 Gm. of the salt, dissolved in 20 C.c. of water (with a few drops of diluted hydrochloric acid), 5 or 6 drops of test-solution of nitrate of barium, no immediate cloudiness or precipitate should make its appearance.
	More than about 0.5 per cent. of Chloride and Bromide.	If 1 Gm. of the salt be dissolved in 10 Gm. of water of ammonia, then shaken with a solution of 1.3 Gm. of nitrate of silver in 20 Gm. of water, and the filtrate be supersaturated with 8 Gm. of nitric acid, no cloudiness should make its appearance within ten minutes.
	Iron.	A 1 per cent. aqueous solution should not be colored blue by test-solution of ferrocyanide of potassium.
	Iodine.	A 1 per cent. aqueous solution, after being mixed with gelatinized starch, should not assume a deep blue color.

Uses.—Ammonium iodide is used as a resolvent and alterative, for the same purposes as potassium iodide. The dose is from three to five grains.

AMMONII NITRAS. *U. S.* Nitrate of Ammonium.

NH_4NO_3; 80.

Preparation.—Ammonium nitrate may be prepared by treating commercial ammonium carbonate with nitric acid so long as effervescence takes place, or to saturation, filtering, and evaporating the solution. If the solution be heated till all the water is driven off, the ammonium nitrate will form, on cooling, an opaque mass.

$$\underset{\text{Acid Ammonium Carbonate and Carbamate.}}{(NH_4HCO_3)NH_4NH_2CO_2} + \underset{\text{Nitric Acid.}}{3HNO_3} = \underset{\text{Ammonium Nitrate.}}{3NH_4NO_3} + \underset{\text{Carbon Dioxide.}}{2CO_2} + \underset{\text{Water.}}{H_2O}.$$

Ammonium nitrate is found commercially either crystallized, granulated, or in fused masses.

Ammonii Nitras. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless crystals, generally in the form of long, thin, rhombic prisms, or in fused masses, somewhat deliquescent.	Odorless; sharp, bitter taste; neutral reaction.	Cold. 0.5 part. Boiling. Very soluble.	Cold. 20 parts. Boiling. 3 parts.

Tests for Identity.	Impurities.	Tests for Impurities.
When gradually heated, the salt melts at 165°–166° C. (329°–331° F.), and at about 185° C. (365° F.) it is decomposed into nitrous oxide gas and water, leaving no residue. The aqueous solution of the salt, when heated with potassa, evolves vapor of ammonia. On heating the salt with sulphuric acid, it emits nitrous vapors.	Chloride.	The aqueous solution of nitrate of ammonium, when acidulated with nitric acid, should not be rendered cloudy by test-solution of nitrate of silver.
	Sulphate.	The aqueous solution, when acidulated with nitric acid, should not be rendered cloudy by test-solution of nitrate of barium.

Uses.—This salt is used largely for preparing nitrogen monoxide (nitrous oxide, or laughing gas) by simply heating the ammonium nitrate and purifying the gas.

$$\underset{\text{Ammonium Nitrate.}}{NH_4NO_3} = \underset{\text{Nitrous Oxide.}}{N_2O} + \underset{\text{Water.}}{2H_2O}.$$

AMMONII PHOSPHAS. *U. S.* Phosphate of Ammonium.

$(NH_4)_2HPO_4$; 132.

Preparation.—This may be prepared by the British officinal process: Take of Diluted Phosphoric Acid 20 fluidounces; Strong Solution of Ammonia a sufficiency. Add the Ammonia to the Phosphoric Acid, until the solution is slightly alkaline, then evaporate the liquid, adding more Ammonia from time to time, so as to keep it in slight excess, and when crystals are formed on the cooling of the solution, dry them quickly on filtering paper placed on a porous tile, and preserve them in a stoppered bottle.

$$\underset{\substack{\text{Ammonia}\\\text{Water.}}}{2NH_4HO} + \underset{\substack{\text{Phosphoric}\\\text{Acid.}}}{H_3PO_4} = \underset{\substack{\text{Ammonium}\\\text{Phosphate.}}}{(NH_4)_2HPO_4} + \underset{\text{Water.}}{2H_2O}.$$

This salt is known chemically as hydrogen di-ammonium phosphate.

Ammonii Phosphas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, translucent, monoclinic prisms, losing ammonia on exposure to dry air. When strongly heated, the salt fuses, afterwards evolves ammonia, and at a bright red heat is wholly dissipated.	Odorless; cooling, saline taste; neutral or faintly alkaline reaction.	Cold. 4 parts. Boiling. 0.5 part.	Insoluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution of the salt, when heated with potassa, evolves vapor of ammonia. Addition of test-solution of nitrate of silver to the aqueous solution produces a canary-yellow precipitate, soluble in nitric acid and in ammonia.	Metals.	The aqueous solution of Phosphate of Ammonium should remain unaffected by sulphide of ammonium, or, after being acidulated with hydrochloric acid, by hydrosulphuric acid.
2 Gm. of the salt, dissolved in water and precipitated with test-mixture of magnesium, yields a crystalline precipitate, which, when washed with diluted water of ammonia, dried, and ignited, should weigh 1.68 Gm.	Sulphate.	The aqueous solution of Phosphate of Ammonium should remain unaffected by test-solution of chloride of barium.
	Chloride.	When Phosphate of Ammonium is acidulated with nitric acid, it should not be rendered turbid by test-solution of nitrate of silver.

Uses.—Ammonium phosphate is used as a remedy in gout and rheumatism, in doses of twenty grains.

AMMONII SULPHAS. *U. S.* Sulphate of Ammonium.

$(NH_4)_2SO_4$; 132.

Preparation.—The impure salt resulting from the sublimation of gas liquor or fetid bone-spirit, saturated with sulphuric acid, is submitted repeatedly to solution and crystallization until obtained pure.

Ammonium sulphate may also be obtained by adding the gas liquor to powdered calcium sulphate contained in a suitable vessel: calcium carbonate remains, whilst the ammonium sulphate is found in solution, which is evaporated. The crystals may be purified by redissolving. filtering, and recrystallizing.

Ammonii Sulphas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, transparent, rhombic prisms, permanent in the air. When heated to about 140° C. (284° F.), the salt fuses, is gradually decomposed, and on ignition is wholly dissipated.	Odorless; sharp, saline taste; neutral reaction.	Cold. 1.3 parts. Boiling. 1 part.	Insoluble in absolute alcohol, but slightly in alcohol of sp. gr. 0.817.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution of the salt, when heated with potassa, evolves vapor of ammonia. With test-solution of chloride of barium it yields a white precipitate insoluble in hydrochloric acid.	Lead and Iron.	A 1 per cent. solution of the salt should not be blackened by test-solution of sulphide of ammonium.
	Chloride.	A 1 per cent. solution of the salt, when acidulated with nitric acid, should not be rendered more than opalescent by test-solution of nitrate of silver.

AMMONII VALERIANAS. *U. S.* Valerianate of Ammonium.

$NH_4C_5H_9O_2$; 119.

Preparation.—This valerianate may be prepared by passing dried gaseous ammonia into monohydrated valerianic acid. The former officinal process may be used, which is as follows:

Take of Valerianic Acid 4 fl. oz.; Chloride of Ammonium, Lime, each, a sufficient quantity. From a mixture of Chloride of Ammonium, in coarse powder, and an equal weight of Lime, previously slaked and in powder, contained in a suitable vessel, obtain gaseous ammonia, and cause it to pass, first through a bottle filled with pieces of Lime, and afterwards into the Valerianic Acid, in a tall, narrow, glass vessel, until the Acid is neutralized. Then discontinue the process, and set the vessel aside that the Valerianate of Ammonium may crystallize. Lastly, break the salt into pieces, drain it in a glass funnel, dry it on bibulous paper, and keep it in a well-stopped bottle.

The salt which is found in commerce is usually the acid salt: hence, in making a solution of it, as in the process for elixir of valerianate of ammonium, the excess of acid should be neutralized by the addition of sufficient water of ammonia.

Ammonii Valerianas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, or white, quadrangular plates, deliquescent in moist air. When heated, the salt fuses, gives off vapor of ammonia and of valerianic acid, and is finally dissipated without leaving a residue.	Valerianic acid odor; sharp and sweetish taste; neutral reaction.	Very soluble.	Very soluble.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution, if heated with potassa, evolves vapor of ammonia, and, if supersaturated with sulphuric acid, separates an oily layer of valerianic acid on the surface.	Acetate.	The aqueous solution, if heated with potassa, evolves vapor of ammonia, and, if supersaturated with sulphuric acid, separates an oily layer of valerianic acid on the surface. If this mixture be neutralized with ammonia, the clear liquid should not be rendered deep red by test-solution of ferric chloride.
	Sulphate.	The aqueous solution of Valerianate of Ammonium, when acidified by nitric acid, should not be precipitated by test-solution of nitrate of barium.
	Chloride.	The aqueous solution of Valerianate of Ammonium, when acidified by nitric acid, should not be precipitated by test-solution of nitrate of silver.

Uses.—Ammonium valerianate is used in hysteria, neuralgia, and similar diseases as a nervine, in doses of five to twenty grains. It is used pharmaceutically in the preparation of an elixir.

SATURATION TABLES.

Table showing the Quantity of Officinal Acids required to Saturate 100 Parts by weight of an Officinal Alkali, together with the Quantity of Product.

Alkalies.	Acidum Aceticum, 36 per cent.		Acid. Aceticum Dil., 6 per cent.		Acid. Acet. Glaciale, 99 per cent.		Acid. Arseniosum, 97 per cent.		Acidum Benzoicum, 100 per cent.		Acidum Citricum, 100 per cent.		Acid. Hydrobrom. Dil., 10 per cent.		Acid. Hydrochlor., 31.9 per cent.		Acid Hydrochlor. Dil., 10 per cent.	
Per cent.		Product.		Product.		Product.		Product.		Product.		Product.		Product.		Product.		Product.
Ammonii Carbonas	100	318	1911	116	147	195	239	233	256	134	166	1544	187	218	695	102
Aqua Ammoniæ	10	98	588	35	45	60	73	72	82	41	51	475	57	67	214	31
Aqua Ammoniæ Fort.	28	274	1647	100	127	170	206	201	229	115	143	1331	161	188	599	88
Potassa	90	268	1607	97	157	54	234	196	362	112	173	1298	191	183	585	119
Liquor Potassæ	5	15	89	5	9	3	13	11	20	6	9	72	10	10	32	6
Potassii Bicarbonas	100	166	1000	60	98	102	146	122	214	70	108	808	119	114	365	74
Potassii Carbonas	81	206	1239	75	115	119	171	143	251	82	127	948	139	134	427	87
Soda	90	375	2250	136	306	219	292	274	364	157	206	1818	231	256	819	131
Liquor Sodæ	5	21	125	7	17	12	16	15	20	9	11	108	13	14	45	7
Sodii Bicarbonas	99	196	1178	71	160	120	153	144	191	82	147	952	121	134	429	69
Sodii Bicarb. Venalis	95	188	1131	68	154	114	147	138	183	79	141	913	116	129	411	66
Sodii Carbonas	96	111	669	40	91	68	87	81	109	47	95	542	69	76	244	39

Alkalies.	Acidum Lacticum, 75 per cent.		Acidum Nitricum, 69.4 per cent.		Acid. Nitricum Dil., 10 per cent.		Acid. Phosphoric., 50 per cent.		Acid. Phos. Dil., 10 per cent.		Acid. Salicylicum, 100 per cent.		Acid. Sulphuricum, 96 per cent.		Acid. Sulph. Dil., 9.8 per cent.		Acid. Tartaricum, 100 per cent.	
Per cent.		Product.		Product.		Product.		Product.		Product.		Product.		Product.		Product.		Product.
Ammonii Carbonas	100	229	204	173	1204	153	187	936	128	263	296	97	975	118	143	176
Aqua Ammoniæ	10	70	62	53	370	47	57	288	39	81	91	30	300	36	44	54
Aqua Ammoniæ Fort.	28	197	176	149	1037	132	161	807	108	227	254	84	840	102	123	151
Potassa	90	193	205	146	1012	162	157	787	140	222	297	82	820	140	120	189
Liquor Potassæ	5	10	11	8	56	9	9	44	8	12	16	4	45	8	6	10
Potassii Bicarbonas	100	120	128	91	630	101	98	490	174	138	185	51	510	174	75	117
Potassii Carbonas	81	141	150	106	739	118	86	430	102	162	217	58	583	102	88	138
Soda	90	273	272	204	1417	191	220	1102	403	155	380	115	1148	362	169	259
Liquor Sodæ	5	15	15	11	79	10	12	61	22	8.5	21	6	64	20	10	14
Sodii Bicarbonas	99	142	132	107	742	100	115	1155	211	162	199	60	601	189	88	135
Sodii Bicarb. Venalis	95	136	126	102	712	96	99	494	202	156	191	57	577	181	85	130
Sodii Carbonas	96	80	75	61	423	57	46	229	120	92	113	34	341	104	50	77

Table showing the Quantity of Officinal Alkalies required to Saturate 100 Parts by weight of an Officinal Acid, together with the Quantity of Product.

Acids.		Ammonii Carbonas, 100 per cent.	Aqua Ammoniæ, 10 per cent.	Aqua Amm. Fort., 28 per cent.	Product.	Potassa, 90 per cent.	Liquor Potassæ, 5 per cent.	Potassii Bicarbonas, 100 per cent.	Potassii Carbonas, 81 per cent.	Product.	Soda, 90 per cent.	Liquor Sodæ, 5 per cent.	Sodii Bicarbonas, 99 per cent.	Sodii Bicarb. Ven., 95 per cent.	Sodii Carbonas, 96 per cent.	Product.
Acidum	*Per cent.*															
Aceticum	36	31	102	36	46	37	672	60	51	59	26	480	51	53	89	81
" Dilutum	6	5	17	6	7	6	112	10	8	10	4	80	8	9	15	13
" Glaciale	99	86	280	100	127	102	1848	165	140	169	73	1319	140	146	246	224
Arseniosum	97	51	166	59	122	61	1098	98	83	147	43	784	83	85	146	127
Benzoicum	100	43	139	50	114	51	918	82	70	175	36	655	69	72	122	133
Citricum	100	75	243	86	121	88	1600	143	121	154	63	1143	123	126	213	178
Hydrobromicum Dil.	10	6	21	7	12	8	138	12	10	14	5	99	10	11	18	12
Hydrochloricum	31.9	46	149	53	47	48	872	87	74	65	39	701	74	77	125	51
" Dil.	10	14	46	16	14	17	307	27	23	20	12	220	23	24	41	16
Lacticum	75	43	141	50	89	52	933	83	71	106	37	666	70	73	124	93
Nitricum	69.4	51	168	60	88	61	1110	99	84	111	44	793	84	87	147	93
" Dilutum	10	8	27	9	12	10	178	16	13	16	7	127	13	14	23	13
Phosphoricum	50	53	173	62	67	63	1143	102	87	89	45	816	86	90	152	182
" Dil.	10	10	34	12	13	12	228	20	17	18	9	167	17	18	30	36
Salicylicum	100	38	123	44	112	45	811	72	123	133	29	521	61	64	108	122
Sulphuricum	96	102	333	119	121	122	2194	196	167	170	87	1567	166	173	292	315
" Dil.	9.6	10	33	12	12	12	219	19	16	17	8	156	16	17	29	31
Tartaricum	100	70	226	81	122	83	1493	133	103	156	59	1066	113	118	198	153

CHAPTER XLII.

MAGNESIUM, CALCIUM, AND BARIUM.

Mg; 24. Ca; 40. Ba; 136.8.

THE compounds of these three metals form a natural group. They have numerous physical and chemical characteristics in common. Barium does not enter into any officinal salts; some of its compounds are used as tests. Magnesium was formerly classed with the alkaline earths, but it is now usually separated from them, because of its closer chemical analogies to zinc. It is so closely allied to the alkaline earths in its pharmaceutical and medical aspects that it will be most useful to consider it in its former relation.

Magnesium, in the forms of chloride, sulphate, carbonate, magnesia-calcic carbonate, and silicate, is widely distributed. The metal is of a silver-white color, losing its lustre through the oxidation of its surface, and burning with a radiant light when heated to redness, magnesia being formed. The oxide, MgO, is officinal, and is largely used medicinally.

Tests for Salts of Magnesium.

1. The caustic alkalies produce gelatinous, white precipitates with solutions of magnesium salts, insoluble in excess, but soluble in solution of ammonium chloride.

2. Sodium carbonate or potassium carbonate produces white precipitates with solutions of magnesium salts.

3. Solution of sodium phosphate produces a white crystalline precipitate, on the addition of a small quantity of water of ammonia, of ammonio-magnesium phosphate, NH_4,Mg,PO_4.

Officinal Preparations of Magnesium.

Officinal Name.	Preparation.
Magnesia	Made by calcining light magnesium carbonate.
Magnesia Ponderosa	Made by calcining heavy magnesium carbonate.
Magnesii Carbonas	Double decomposition between magnesium sulphate and sodium carbonate.
Magnesii Citras Granulatus	Made from magnesium carbonate, citric acid, sodium bicarbonate, sugar, alcohol, and distilled water.
Magnesii Sulphas	By treating native magnesium hydrate with sulphuric acid.
Magnesii Sulphis	By treating magnesia in suspension with sulphurous acid.
Liquor Magnesii Citratis	By dissolving magnesium carbonate in citric acid, flavoring, and adding potassium bicarbonate.
Mistura Magnesiæ et Asafœtidæ	Contains magnesia, tinctures of asafœtida and opium, sugar, and water.
Trochisci Magnesiæ	8 grains of magnesia in each lozenge.

Unofficinal Salts of Magnesium.

Magnesii Acetas, $Mg(C_2H_3O_2)_2$, = 142. Acetate of Magnesium.	By dissolving 10 p. magnesium carbonate in sufficient acetic acid, filtering and concentrating, then crystallizing.
Magnesii Iodidum, MgI_2, = 277.2. Iodide of Magnesium.	By dissolving magnesia in hydriodic acid, filtering and concentrating, then crystallizing.
Magnesii Lactas, $Mg2C_3H_5O_3.3H_2O$, = 256. Lactate of Magnesium.	By dissolving separately in hot water 6 p. calcium lactate and 5 p. magnesium sulphate, mixing the solutions and filtering, evaporating the filtrate, then crystallizing.
Magnesii Silicas. Silicate of Magnesium.	Occurs in nature.
Magnesii Sulphas Exsiccatus, $MgSO_4$. Dried Sulphate of Magnesium.	By exposing the crystallized sulphate in a warm place until it has lost 35 per cent. of its weight, then sifting it.
Magnesii Sulphocarbolas, $Mg2C_6H_5SO_4.7H_2O$, = 496. Sulphocarbolate of Magnesium.	By mixing concentrated solutions of barium sulphocarbolate and magnesium carbonate and collecting the precipitate.

MAGNESIA. *U. S.* Magnesia.

MgO; 40. [LIGHT MAGNESIA.]

Preparation.—Magnesium carbonate is exposed in crucibles to a red heat, carbon dioxide and water are expelled, and magnesia is left.

$$\underset{\text{Magnesium Carbonate.}}{(MgCO_3)_4Mg(HO)_2} + \underset{\text{Water.}}{5H_2O} = \underset{\text{Magnesia.}}{5MgO} + \underset{\text{Carbon Dioxide.}}{4CO_2} + \underset{\text{Water.}}{6H_2O}.$$

Magnesia is rendered less soluble if heated too strongly. Magnesia should always be kept in well-closed vessels: exposure to air and moisture causes the formation of carbonate and hydrate.

Magnesia. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, very light and very fine powder, slowly absorbing carbonic acid from the air. Magnesia is not altered or affected by heat.	Odorless; an earthy, but no saline taste; faintly alkaline reaction when moistened with water.	Almost insoluble.	Insoluble.

Tests for Identity.	Impurities.	Tests for Impurities.
On stirring 1 part of Magnesia with 15 parts of water, in a beaker, and allowing the mixture to stand for about half an hour, it will form a gelatinous mass of sufficient firmness to prevent it from falling out when the glass is inverted. A filtered solution of Magnesia in diluted sulphuric acid, mixed with chloride of ammonium and supersaturated with water of ammonia, yields, with test-solution of phosphate of sodium, a copious white precipitate, soluble in acids.	Carbonate.	On dropping a small portion of Magnesia into hot water, waiting until all air-bubbles have escaped, and then pouring the mixture into an excess of diluted sulphuric acid, no effervescence should take place.
	More than traces of other Alkaline Earths.	No insoluble residue should remain after treating Magnesia with warm water and diluted sulphuric acid.
	Sulphate.	A solution of Magnesia in a slight excess of diluted nitric acid should yield at most only a faint cloudiness with test-solution of chloride of barium.
	Chloride.	A solution of Magnesia in a slight excess of diluted nitric acid should yield at most only a faint cloudiness with test-solution of nitrate of silver.

Uses.—Magnesia is popularly used as a laxative and antacid, in doses of thirty grains. In administering, the magnesia should be added to the diluent, water or milk, and not *vice versa.*

MAGNESIA PONDEROSA. *U.S.* Heavy Magnesia.

MgO; 40.

A white, dense, and very fine powder, corresponding in all other properties and reactions with Magnesia. Heavy magnesia is preferable to the ordinary magnesia, on account of its density. This often permits the decrease in bulk of the dose in the ratio of nearly four to one. Magnesia is rendered less bulky by trituration; and if the heavy carbonate is used for the calcination, a heavier powder is produced. The tests and uses of heavy magnesia are the same as those of the light magnesia.

MAGNESII CARBONAS. *U.S.* Carbonate of Magnesium.

$(MgCO_3)_4.Mg(HO)_2.5H_2O$; 484.

Preparation.—The process of the British Pharmacopœia is as follows: Take of Sulphate of Magnesia 10 ounces [avoirdupois]; Carbonate of Soda 12 ounces [avoird.]; Boiling Distilled Water a sufficiency. Dissolve the Sulphate of Magnesia and Carbonate of Soda, each, in a pint [Imp. Meas.] of the Water, mix the two solutions, and evaporate the whole to perfect dryness, by means of a sand-bath. Digest the residue for half an hour with two pints [Imp. Meas.] of the Water, and, having collected the insoluble matter on a calico filter, wash it repeatedly with Distilled Water, until the washings cease to give a precipitate with chloride of barium. Finally, dry the product at a temperature not exceeding 212° F.

Magnesium carbonate varies in composition somewhat according to the process used. The reaction in making the U. S. carbonate would in its preparation be as follows:

$$\underset{\text{Magnesium Sulphate.}}{5MgSO_4} + \underset{\text{Sodium Carbonate.}}{5Na_2CO_3} + \underset{\text{Water.}}{H_2O} = \underset{\text{Magnesium Carbonate.}}{4MgCO_3,Mg(HO)_2} + \underset{\text{Sodium Sulphate.}}{5Na_2SO_4} + \underset{\text{Carbon Dioxide.}}{CO_2}.$$

The process for making light magnesium carbonate differs from the above in the substitution of a larger proportion of cold water for the boiling water. This furnishes a good illustration of the general rule in precipitation, that dilute solutions produce light precipitates, and dense solutions heavy precipitates.

Magnesii Carbonas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Light, white, friable masses, or a light, white powder. When strongly heated, it loses water and carbonic acid gas, and is converted into magnesia.	Odorless; tasteless; feebly alkaline reaction.	Almost insoluble.	Insoluble.

Tests for Identity.	Impurities.	Tests for Impurities.
It is soluble in diluted hydrochloric acid, with copious effervescence. On supersaturating this solution with water of ammonia, and adding test-solution of phosphate of sodium, a white, crystalline precipitate, soluble in acids, is thrown down.	Aluminium or more than traces of Calcium.	The salt should be soluble in diluted hydrochloric acid to a colorless liquid; on supersaturating the clear solution with test-solution of carbonate of ammonium, it should not be rendered more than faintly opalescent. Distilled water, boiled with the salt, and, after filtration, evaporated to dryness, should not leave more than a trace of residue.
	Metals.	A 2 per cent. solution of the salt, prepared with the aid of acetic acid, should not be affected by hydrochloric acid, nor, after addition of test-solution of carbonate of ammonium with an excess of water of ammonia, by solution of sulphide of ammonium.
	Limit of Sulphate.	Another portion of the 2 per cent. solution should not at once be rendered more than faintly opalescent by test-solution of nitrate of barium.
	Chloride.	Another portion of the 2 per cent. solution should not at once be rendered more than faintly opalescent by test-solution of nitrate of silver.

Uses.—Magnesium carbonate is antacid, and in large doses cathartic. The dose is from thirty to sixty grains. It has been largely employed in making medicated waters to assist in diffusing the oils used in preparing them.

MAGNESII CITRAS GRANULATUS. *U. S.* Granulated Citrate of Magnesium.

Carbonate of Magnesium, 11 parts, or	3 oz. av. 292 gr.
Citric Acid, 48 parts, or	16 oz. av.
Bicarbonate of Sodium, 37 parts, or	12 oz. av. 146 gr.
Sugar, in No. 60 powder, 8 parts, or	2 oz. av. 292 gr.
Alcohol,	
Distilled Water, each, a sufficient quantity,	
To make 100 parts, or about	32 oz. av.

Mix the Carbonate of Magnesium intimately with *thirty-three parts* [or 11 oz. av.] of Citric Acid, and enough Distilled Water to make a thick paste; dry this at a temperature not exceeding 30° C. (86° F.), and reduce it to a fine powder. Then mix it intimately with the Sugar, the Bicarbonate of Sodium, and the remainder of the Citric Acid previously reduced to a very fine powder. Dampen the mass with a sufficient quantity of Alcohol, and rub it through a No. 20 tinned-iron sieve, to form a coarse, granular powder. Lastly, dry it in a moderately warm place. Granulated Citrate of Magnesium should be kept in well-closed bottles.

This is the only officinal effervescent granular salt. It is intended to furnish an agreeable, effervescent draught. It is very important to obey the direction to keep it in well-closed bottles, for if access of air be permitted, the moisture will soon cause the acid to act upon the carbonates and liberate the carbonic acid gas gradually, and thus destroy the effervescent character of the draught, which is its principal recommendation.

Magnesii Citras Granulatus. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, coarsely granular salt, deliquescent on exposure to air.	Odorless; mildly acidulous, refreshing taste; acid reaction.	Cold. 2 parts, with copious effervescence. Boiling. Very soluble.	Almost insoluble.

Tests for Identity.	Impurities.	Test for Impurities.
On adding chloride of ammonium to the aqueous solution of the salt, a portion of the liquid, when mixed with excess of solution of phosphate of ammonium and water of ammonia, yields a white, crystalline precipitate, soluble in acids. On mixing another portion with test-solution of chloride of calcium, supersaturating with water of ammonia and filtering, the filtrate deposits a white precipitate on boiling.	Tartrate.	The saturated solution of the salt, when mixed with a saturated solution of acetate of potassium and some acetic acid, should not yield a white, crystalline precipitate.

Uses.—Granulated citrate of magnesium is given as a pleasant cathartic, in doses of one to three teaspoonfuls, in cold water.

MAGNESII SULPHAS. *U.S.* Sulphate of Magnesium.

$MgSO_4 7H_2O$; 246. [Epsom Salt.]

Preparation.—This well-known salt is prepared from a number of mineral substances, but in the United States, principally from a silicious magnesium hydrate, which is practically free from lime. The mineral is reduced to a fine powder and treated with sulphuric acid. The mass is then dried and calcined at a red heat, in order to convert into red oxide any ferrous sulphate which may be present. It is then dissolved in water, and calcium sulphide added to separate any remaining portion of iron. The salt is crystallized and dissolved a third time, in order to purify it.

In England, Epsom salt is sometimes prepared from *dolomite*, the double carbonate of magnesium and calcium, by driving off the carbon dioxide by heat, converting the residue into hydrates, and then treating these with hydrochloric acid. Calcium chloride is formed, this is dissolved out by washing with water, and the purified magnesia is converted into sulphate by treating it with sulphuric acid.

Magnesii Sulphas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Small, colorless, right-rhombic prisms, or acicular needles, slowly efflorescent in dry air. When heated, the salt gradually loses nearly 44 per cent. of its weight (water of crystallization), and at a strong red heat it fuses, congealing on cooling to a white mass, which amounts to 48.7 per cent. of the original weight.	Odorless; cooling, saline and bitter taste; neutral reaction.	Cold. 0.8 part. Boiling. 0.15 part.	Insoluble.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution, mixed with solution of chloride of ammonium, yields, with excess of test-solution of phosphate of sodium and water of ammonia, a white, crystalline precipitate, soluble in acids. With test-solution of chloride of barium it yields a white precipitate insoluble in hydrochloric acid.	Metals.	The aqueous solution should not be colored nor be precipitated by test-solution of ferrocyanide of potassium, hydrosulphuric acid, or sulphide of ammonium.
	Alkaline Earths.	A 5 per cent. solution, after addition of chloride of ammonium, should not be precipitated nor rendered turbid by test-solution of carbonate of ammonium and water of ammonia.
	Chloride.	A 1 per cent. solution should not yield more than a slight opalescence with test-solution of nitrate of silver.
	More than about 1 per cent. of Sulphates of Alkalies.	If an aqueous solution of 1 Gm. of the salt, mixed with chloride of ammonium, be completely precipitated by solution of phosphate of ammonium and water of ammonia, the filtrate evaporated to dryness, the residue gently ignited and then dissolved in 5 C.c. of water, this solution, acidulated with a few drops of hydrochloric acid, should not become more than faintly opalescent on mixing 1 volume of it with 2 volumes of alcohol, nor on adding test-solution of chloride of barium to another portion.

Uses.—Sulphate of magnesium is a valuable refrigerant cathartic, in doses of one ounce: if dissolved in iced water, its nauseous taste is not so perceptible as when water of ordinary temperature is used.

MAGNESII SULPHIS. *U. S.* Sulphite of Magnesium.

$MgSO_3 6H_2O$; 212.

Preparation.—This salt is easily prepared by passing purified sulphurous acid gas into a rather thick milk of magnesia until the acid is in slight excess.

Magnesii Sulphis. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, crystalline powder, gradually becoming oxidized on exposure to air. When heated to 200° C. (392° F.), the salt loses its water of crystallization (50.9 per cent.), and is converted into magnesia and anhydrous sulphate of magnesium.	Odorless; slightly bitter, somewhat sulphurous taste; neutral or slightly alkaline reaction.	Cold. 20 parts. Boiling. 19 parts.	Insoluble.

Tests for Identity.	Impurities.	Test for Impurities.
The aqueous solution of the salt, mixed with chloride of ammonium, yields, with excess of test-solution of phosphate of sodium and water of ammonia, a white, crystalline precipitate soluble in acids. When treated with 4 times its weight of diluted hydrochloric acid, the salt dissolves completely and emits the odor of burning sulphur, without becoming cloudy (difference from hyposulphite).	Sulphate.	A 1 per cent. aqueous solution, strongly acidulated with hydrochloric acid, should not afford more than a slight cloudiness with test-solution of chloride of barium.

Uses.—Magnesium sulphite has an advantage over the sodium and potassium salts in being less soluble, and hence less disagreeable to the taste. The dose is fifteen to thirty grains.

LIQUOR MAGNESII CITRATIS. *U.S.* **Solution of Citrate of Magnesium.**

Carbonate of Magnesium, 200 grains	200 grains.
Citric Acid, 400 grains	400 grains.
Syrup of Citric Acid, 1200 grains, or	2 fl. oz.
Bicarbonate of Potassium, in crystals, 30 grains	30 grains.
Water, a sufficient quantity.	

Dissolve the Citric Acid in *two thousand grains* [or 4 fluidounces] of Water, and, having added the Carbonate of Magnesium, stir until it is dissolved. Filter the solution into a strong bottle of the capacity of 12 *fluidounces*, containing the Syrup of Citric Acid. Then add enough Water, previously boiled and filtered, to nearly fill the bottle, drop in the Bicarbonate of Potassium, and immediately close the bottle with a cork, which must be secured with twine. Lastly, shake the mixture occasionally until the Bicarbonate of Potassium is dissolved.

A few modifications in the manipulation of the officinal process are advisable. The bulky magnesium carbonate may be replaced by one-half of the quantity of Jenning's light calcined magnesia. The syrup of citric acid should be introduced into the bottle, and the filtered solution of magnesium citrate very carefully poured in without stirring up the syrup. The potassium bicarbonate, in large crystals, is dropped into the bottle,—they gradually dissolve in the syrup of citric acid,—and the cork is at once inserted, to prevent loss of carbonic acid gas. The bottle is not disturbed until it is called for, when a vigorous shake mixes the solution of the bicarbonate in the bottom of the bottle with the acid liquid above, liberating the carbonic acid gas, and the solution can then always be dispensed in a sparkling condition.

Uses.—"Solution of citrate of magnesia," as it will probably be always called, is one of the most agreeable cathartics known. It is usually given in the quantity made by the officinal formula,—twelve fluidounces. The practice of dividing the dose, taking one-half three or four hours after the other, is often preferable.

MISTURA MAGNESIÆ ET ASAFŒTIDÆ. *U.S.* **Mixture of Magnesia and Asafetida.**

This mixture is the only officinal one containing magnesia. It is popularly known as Dewees's carminative. For the formula, see page 274.

TROCHISCI MAGNESIÆ. *U.S.* **Troches of Magnesia.**

Each troche contains three grains of magnesia (see Part VI.).

Calcium. Ca; 40.

Calcium is a very abundant element, occuring in nature as carbonate, sulphate, phosphate, silicate, chloride, fluoride, etc. It belongs to the class of metals. When heated, it burns with a bright light. It is of a

light yellow color, and is ductile, like gold: it may be hammered into very thin sheets. It forms but one chloride. The oxide, carbonate, sulphate, phosphate, and hypophosphite are of pharmaceutical interest.

Tests for Salts of Calcium.

1. Alkaline carbonates produce white precipitates with soluble salts of calcium, insoluble in excess.

2. The soluble oxalates (ammonium or potassium oxalate) produce, even in dilute solutions of calcium salts, a white precipitate of calcium oxalate, not soluble in an excess of acetic acid, but soluble in an excess of hydrochloric acid.

Officinal Preparations of Calcium.

Officinal Name.	Preparation.
Calx	Made by calcining chalk or limestone.
Calx Chlorata	By treating calcium hydrate with chlorine.
Calx Sulphurata	By heating lime and sulphur to a low red heat.
Calcii Bromidum	By dissolving lime in hydrobromic acid.
Calcii Carbonas Præcipitatus	By double decomposition between calcium chloride and sodium carbonate.
Calcii Chloridum	By acting on calcium carbonate with hydrochloric acid.
Calcii Hypophosphis	By heating phosphorus with milk of lime.
Calcii Phosphas Præcipitatus	By treating bone-ash with HCl, and precipitating with ammonia.
Creta Præparata	By elutriating chalk and forming into cones.
Pulvis Cretæ Compositus	Chalk, sugar, gum, etc., for making chalk-mixture.
Mistura Cretæ	Compound chalk powder suspended in cinnamon-water and water.
Trochisci Cretæ	Each containing 4 grains of prepared chalk.
Liquor Calcis	By dissolving lime in water.
Linimentum Calcis	Equal parts of lime-water and cotton-seed oil.
Syrupus Calcis	A saccharine solution of lime.
Syrupus Calcii Lactophosphatis	A saccharine solution of calcium lactophosphate.

Unofficinal Salts of Calcium.

Calcii Hydras, $Ca(HO)_2$, = 74. Hydrate of Calcium.	By adding 1 p. water to 2 p. lime contained in a metal pot, covering and setting aside to cool, sifting and preserving the fine powder.
Calcii Iodas, $Ca2IO_3.6H_2O$, = 497.2. Iodate of Calcium.	By mixing gradually an alcoholic solution of iodine with excess of filtered aqueous solution of chlorinated lime. After decolorization, slightly acidulating with hydrochloric acid, heating to boiling, filtering, then crystallising.
Calcii Iodidum, CaI_2, = 293.2. Iodide of Calcium.	By dissolving slaked lime in hydriodic acid and concentrating, then crystallising.
Calcii Oxysulphidum. Oxysulphide of Calcium.	By mixing 50 p. sulphur, 150 p. slaked lime, 250 p. water, boiling, stirring frequently until a portion dropped on a cold slab will solidify, then pouring on a marble slab to cool.
Calcii Sulphidum, CaS, = 72. Sulphide of Calcium.	By mixing 12 p. powdered gypsum with 4 p. powdered charcoal, and heating the mixture in a covered crucible until gas ceases to be evolved.
Calcii Sulphas, $CaSO_4.2H_2O$, = 172. Sulphate of Calcium.	Occurs in nature.
Calcii Sulphis, $CaSO_3$, = 120. Sulphite of Calcium.	By mixing concentrated solutions of sodium sulphite and calcium chloride and collecting the precipitate.
Calcii Sulphocarbolas, $Ca2C_6H_5SO_4.6H_2O$, = 602. Sulphocarbolate of Calcium.	By mixing concentrated solutions of barium sulphocarbolate and calcium carbonate and collecting the precipitate.
Calcii Sulphydras, CaH_2S_2, = 196. Sulphydrate of Calcium.	By passing hydrosulphuric acid into a mixture of 2 p. slaked lime and 3 p. water as long as absorbed.

CALX. *U. S.* Lime.

CaO; 56.

Preparation.—Lime, or calcium oxide, is a very important alkaline earth, and is made by calcining limestone, or native calcium carbonate, in kilns with strong heat: carbon dioxide and water are expelled.

Calx. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Hard, white or grayish-white masses, gradually attracting moisture and carbonic acid gas on exposure to air and falling to a white powder.	Odorless; sharp, caustic taste; alkaline reaction.	Cold. 750 parts. Boiling. 1300 parts.	Insoluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
When heated to a white heat, Lime is neither fused nor altered. Brought into contact with about half its weight of water, it absorbs the latter, becomes heated, and is gradually converted into a white powder (slaked lime). Distilled water agitated with slaked lime should give the reactions mentioned under Liquor Calcis.	Carbonate.	Lime mixed with water to a thin milk should be dissolved by nitric acid with but little effervescence.
	Insoluble Matter.	The above mixture should not leave more than a slight residue.

Uses.—Externally, lime acts as an escharotic: it enters into the composition of many depilatory powders; internally, in solution, it is a valuable antacid.

LIQUOR CALCIS. *U. S.* Solution of Lime.

[Lime-water.]

An aqueous solution containing about 0.15 per cent. of Hydrate of Calcium [$Ca(HO)_2$; 74].

Lime, 1 part, or . . . . . ½ oz. av.
Water,
Distilled Water, each, a sufficient quantity.

Slake the Lime by the gradual addition of *six parts* [or 3 fl. oz.] of Water, then add *thirty parts* [or 1 pint] of Water and stir occasionally during half an hour. Allow the mixture to settle, decant the liquid and throw it away. Then add to the residue *three hundred parts* [or 8 pints] of Distilled Water, stir well, wait a short time for the coarser particles to subside, and pour the liquid, holding the undissolved Lime in suspension, into a glass-stoppered bottle. Pour off the clear liquid when wanted for use.

Lime-water is very extensively used in pharmacy: the object of keeping it upon undissolved Lime is to insure a saturated solution. Lime is but sparingly soluble in water, and less soluble in hot water than in cold: when the solution is heated, a deposition of lime takes place, which is redissolved on cooling.

Liquor Calcis. *U.S.*	Odor, Taste, and Reaction.	Solubility.
A clear, colorless liquid. Sp. gr. 1.0015 at 15° C. (59° F.). When heated to boiling, it becomes cloudy.	Odorless; saline and feebly caustic taste; alkaline reaction.	Miscible with water and alcohol in all proportions.

Test for Identity.	Impurities.	Test for Impurities.
Test-solution of oxalic acid added to it produces a white precipitate soluble in hydrochloric, but insoluble in acetic acid.	Alkalies or their Carbonates.	The alkaline reaction of the liquid entirely disappears after it has been saturated with carbonic acid gas and the excess of the latter has been expelled by boiling.

Uses.—Probably the most extensive use of lime-water in medicine is in checking nausea. It is usually administered with milk when used for this purpose. It is employed externally to allay inflammation, and in washes of various kinds. The dose of lime-water is from two to four fluidounces.

SYRUPUS CALCIS. *U.S.* Syrup of Lime.

A syrupy liquid made by boiling five parts of lime and thirty parts of sugar in fifty parts of water, and adding sufficient water to make one hundred parts. Lime is more soluble in syrup than in water, and hence this syrup is more strongly alkaline than lime-water: this is accounted for by the fact that lime forms soluble saccharates with sugar (see page 262).

LINIMENTUM CALCIS. *U.S.* Lime Liniment.

This liniment is made by mixing equal weights of lime-water and cotton-seed oil. It is used largely as an external application for burns, and is sometimes called Carron oil (see page 287).

CALX CHLORATA. *U.S.* Chlorinated Lime.

The activity of this compound depends upon the amount of chlorine present, and it is therefore most appropriately considered under that head (see page 421).

CALX SULPHURATA. *U.S.* Sulphurated Lime.

A mixture (commonly misnamed Sulphide of Calcium) consisting chiefly of Sulphide of Calcium [CaS; 72] and Sulphate of Calcium [$CaSO_4$; 136], in varying proportions, but containing not less than 36 per cent. of absolute Sulphide of Calcium.

Lime, in very fine powder, 100 parts, or	10 oz. av.
Precipitated Sulphur, 90 parts, or	9 oz. av.
To make . . . . . about	16 oz. av.

Mix the Lime and Sulphur intimately, pack the mixture with gentle pressure in a crucible so as nearly to fill it, and, having luted down the cover, expose the crucible for one hour to a low red heat, by means of a charcoal fire so arranged that the upper part of the crucible shall be

heated first. Then remove the crucible, allow it to cool, rub its contents to powder, and at once transfer the latter to small, glass-stoppered vials.

This is not a definite chemical compound, but contains varying amounts of the active constituent, calcium sulphide.

Calx Sulphurata. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A grayish-white or yellowish-white powder, gradually altered by exposure to air. On dissolving Sulphurated Lime with the aid of acetic acid, hydrosulphuric acid is abundantly given off, and a white precipitate (sulphate of calcium) is thrown down. The filtrate yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid.	Exhaling a faint odor of hydrosulphuric acid; offensive alkaline taste; alkaline reaction.	Cold. Very slightly soluble.	Insoluble.

Quantitative Test.

If 1 Gm. of Sulphurated Lime be gradually added to a boiling solution of 1.25 Gm. of sulphate of copper in 50 C.c. of water, the mixture digested on a water-bath for fifteen minutes, and filtered when cold, no color should be imparted to the filtrate by 1 drop of test-solution of ferrocyanide of potassium (presence of at least 36 per cent. of real Sulphide of Calcium).

Uses.—Sulphurated lime is used as a depilatory for removing superfluous hair from the body, by mixing a small quantity with water and applying the paste to the part. It is used internally in acne and other skin diseases: the dose is one-half grain to one grain.

CALCII BROMIDUM. *U.S.* Bromide of Calcium.

$CaBr_2$; 199.6.

Preparation.—Calcium bromide may be made by the simple process of adding precipitated calcium carbonate, in excess, to hydrobromic acid, filtering, evaporating the solution to dryness, and granulating the product.

It may also be made by adding milk of lime to a boiling solution of ammonium bromide until ammoniacal vapors cease to be evolved. The solution is then filtered, and the salt granulated.

$$\underset{\text{Calcium Carbonate.}}{CaCO_3} + \underset{\text{Hydrobromic Acid.}}{2HBr} = \underset{\text{Calcium Bromide.}}{CaBr_2} + \underset{\text{Water.}}{H_2O} + \underset{\text{Carbon Dioxide.}}{CO_2}.$$

Calcii Bromidum. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, granular salt, very deliquescent. At a dull red heat the salt fuses without losing anything but moisture. At a higher temperature it is partially decomposed.	Odorless; pungent, saline, and bitter taste; neutral reaction.	Cold. 0.7 part. Boiling. Very soluble.	Cold. 1 part. Boiling. Very soluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
An aqueous solution of the salt yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid. If disulphide of carbon be poured into a solution of the salt, then chlorine water added drop by drop, and the whole agitated, the disulphide will acquire a yellow or yellowish-brown color without a violet tint. 1 Gm. of the dry salt, when completely precipitated by nitrate of silver, yields, if perfectly pure, 1.878 Gm. of dry bromide of silver.	Bromate.	If diluted sulphuric acid be dropped upon the salt, the latter should not at once assume a yellow color.
	Iodide.	If 1 Gm. of the salt be dissolved in 10 C.c. of water, some gelatinized starch added, and then a few drops of chlorine water carefully poured on top, no blue zone should make its appearance at the line of contact of the two liquids.
	Sulphate.	On adding to 1 Gm. of the salt dissolved in 20 C.c. of water, 5 or 6 drops of test-solution of nitrate of barium, no immediate cloudiness or precipitate should make its appearance.
	Chloride.	If a solution of the salt be precipitated with an excess of nitrate of silver, the washed precipitate for some time shaken with a cold, saturated solution of carbonate of ammonium, and the decanted and filtered liquid supersaturated with nitric acid, not more than a faint cloudiness, insufficient to produce a precipitate, should appear.
	Magnesium.	On adding to the aqueous solution of the salt, first, chloride of ammonium, then test-solution of carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate of sodium.

Uses.—Calcium bromide is used as a hypnotic, in doses of thirty to sixty grains.

CALCII CARBONAS PRÆCIPITATUS. *U.S.* Precipitated Carbonate of Calcium.

$CaCO_3$; 100.

Preparation.—This salt is readily prepared by double decomposition. The following process is officinal in the British Pharmacopœia:

Take of Chloride of Calcium 5 oz. av.; Carbonate of Soda 13 oz. av.; Boiling Distilled Water a sufficiency. Dissolve the Chloride of Calcium and the Carbonate of Soda each in 2 pints [Imperial measure] of the Water; mix the two Solutions; and allow the precipitate to subside. Collect this on a calico filter, wash it with boiling Distilled Water until the washings cease to give a precipitate with nitrate of silver, and dry the product at the temperature of 212° (F.).

Calcium carbonate precipitates, and sodium chloride remains in solution.

$$\underset{\text{Calcium Chloride.}}{CaCl_2} + \underset{\text{Sodium Carbonate.}}{Na_2CO_3} = \underset{\text{Calcium Carbonate.}}{CaCO_3} + \underset{\text{Sodium Chloride.}}{2NaCl.}$$

The fineness of the powder is greatly promoted by using hot, dense solutions.

This salt of calcium is also obtained as a by-product in the process for making solution of chlorinated soda, double decomposition taking place between solution of chlorinated lime and solution of sodium carbonate. The precipitated calcium carbonate must be boiled in water, and afterwards thoroughly washed, to free it from the chlorinous odor. The product is unfit for internal use.

Calcii Carbonas Precipitatus. *U. S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A very fine, white, impalpable powder, permanent in the air. By exposure to a red heat the salt loses carbonic acid gas, and the residue has an alkaline reaction.	Odorless; tasteless.	Insoluble.	Insoluble.	Wholly soluble in hydrochloric, nitric, or acetic acid, with copious effervescence.

Test for Identity.	Impurities.	Tests for Impurities.
A neutral solution of the salt in acetic acid yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid.	Magnesium.	On adding to a neutral solution of the salt in acetic acid, first, chloride of ammonium, then test-solution of carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate of sodium.
	Aluminium, Iron, or Phosphate.	A solution of the salt in hydrochloric acid, freed from carbonic acid gas by heat, should not be rendered turbid when supersaturated with water of ammonia.

Uses.—This form of calcium carbonate, known popularly as *precipitated chalk*, is largely used in tooth-powders and similar preparations: it is inferior to the prepared chalk as an ingredient in chalk mixtures, because it does not possess the adhesive powers of the latter.

CRETA PRÆPARATA. *U. S.* Prepared Chalk.

Native, friable Carbonate of Calcium [$CaCO_3$; 100], freed from most of its impurities by elutriation.

Preparation.—The process formerly officinal is as follows:

Take of Chalk *a convenient quantity*. Add a little water to the Chalk, and rub it into fine powder. Throw this into a large vessel nearly full of water, stir briskly, and, after a short interval, decant the supernatant liquor, while yet turbid, into another vessel. Treat the coarser particles of the Chalk, remaining in the first vessel, in a similar manner, and add the turbid liquid to that previously decanted. Lastly, set the liquor by, that the powder may subside, and, having poured off the water, dry the powder.

The object of this process is to effect the separation of the gritty particles in ordinary chalk by elutriation. It is usual to form the moist powder into cones by trochiscation (see page 163). Whilst elutriation effects the purification of the chalk to a certain extent, it does not separate the insoluble fine particles, and hence prepared chalk is chemically not so pure as precipitated carbonate of calcium.

Prepared chalk differs greatly in appearance from precipitated chalk, even after it has been reduced to a fine powder. It is usually not so white as the latter, and it adheres to the fingers when handled. This adhesiveness fits it for many purposes. *Whiting*, a cheap form of prepared chalk, is used for polishing.

Creta Præparata. *U.S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A white, amorphous powder, generally agglutinated in form of small cones, permanent in the air. By exposure to a red heat the salt loses carbonic acid gas, and the residue has an alkaline reaction.	Odorless; tasteless.	Insoluble.	Insoluble.	Soluble in hydrochloric, nitric, or acetic acid, with copious effervescence, and without leaving more than a trifling residue.

Test for Identity.	Impurities.	Tests for Impurities.
A neutral solution of the salt in acetic acid yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid.	Barium or Strontium.	A portion of a neutral solution of the salt in acetic acid should yield no precipitate with test-solution of sulphate of calcium.
	Magnesium.	On adding to a neutral solution of the salt in acetic acid, first, chloride of ammonium, then carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate of sodium.
	Iron.	A portion of a neutral solution of the salt in acetic acid should not assume more than a slightly bluish tint with a few drops of test-solution of ferrocyanide of potassium.

Uses.—This is the form of chalk which is used in medicine almost exclusively: it is an antacid, and is admirably adapted for the treatment of diarrhœa. It is used in the compound chalk powder and in troches of chalk.

CALCII CHLORIDUM. *U.S.* Chloride of Calcium.

$CaCl_2$; 110.8.

Chloride of Calcium, deprived of its water by fusion at a low red heat. It should be preserved in well-stopped bottles.

Preparation.—Chloride of calcium may be readily formed by saturating hydrochloric acid with chalk or marble, evaporating to dryness, and heating to redness.

$$\underset{\text{Calcium Carbonate.}}{CaCO_3} + \underset{\text{Hydrochloric Acid.}}{2HCl} = \underset{\text{Calcium Chloride.}}{CaCl_2} + \underset{\text{Carbon Dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O}.$$

It is frequently obtained as a by-product in chemical operations.

Calcii Chloridum. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, slightly translucent, hard and friable masses, very deliquescent. At a low red heat the salt fuses to an oily liquid, which, on cooling, solidifies to a mass of the original appearance, entirely soluble in water.	Odorless; hot, sharp, saline taste; neutral or faintly alkaline reaction.	Cold. 1.5 parts. Boiling. Very soluble.	Cold. 8 parts. Boiling. 1.5 parts.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution yields, with test-solution of oxalate of ammonium, a white precipitate, soluble in hydrochloric, but insoluble in acetic acid. With test-solution of nitrate of silver it yields a white precipitate soluble in ammonia.	Aluminium, Iron.	The dilute aqueous solution of the salt should not be precipitated by water of ammonia.
	Sulphate.	The dilute aqueous solution of the salt should not be precipitated by test-solution of chloride of barium.
	Magnesium.	On adding to the aqueous solution of the salt, first, chloride of ammonium, then test-solution of carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate of sodium.

Uses.—Calcium chloride, when in fused masses, is used in chemical operations for dehydrating gases: this it does through its powerful affinity for water.

CALCII HYPOPHOSPHIS. *U.S.* Hypophosphite of Calcium.

$CaH_4(PO_2)_2$; 170.

Preparation.—This salt is made by boiling milk of lime and phosphorus together until the spontaneously inflammable gas, phosphoretted hydrogen, ceases to be evolved: it is necessary to provide for the safe escape of this gas by conducting it by a hood into a powerful draught.

$$\underset{\text{Phosphorus.}}{8P} + \underset{\substack{\text{Calcium}\\\text{Hydrate.}}}{3CaH_2O_2} + \underset{\text{Water.}}{6H_2O} = \underset{\substack{\text{Calcium}\\\text{Hypophosphite.}}}{3CaH_4(PO_2)_2} + \underset{\substack{\text{Phosphoretted}\\\text{Hydrogen.}}}{2PH_3}$$

The liquid is filtered to separate the insoluble phosphate and residuary lime, then concentrated, and refiltered to separate the calcium carbonate formed by the action of the air on a little lime held in solution, and lastly evaporated till a pellicle appears; after which the salt may be allowed to crystallize by setting the liquid aside, or may be obtained in the granular form by continuing the heat, and stirring.

The heat employed in evaporating the solution should not be above 85° C. (185° F.), for fear of explosions, several accidents having occurred through carelessness in this respect, even when the evaporation was conducted with a water-bath.

Calcii Hypophosphis. *U.S.*	Odor, Taste, and Reaction	Solubility.	
		Water.	Alcohol.
Colorless or white, six-sided prisms, or thin, flexible scales, of a pearly lustre, permanent in dry air. When heated in a dry test-tube, the salt decrepitates, gives off water, then evolves spontaneously-inflammable phosphoretted hydrogen, leaving a reddish residue which amounts to about 80 per cent.	Odorless; nauseous, bitter taste; neutral reaction.	Cold. 6.8 parts. Boiling. 6 parts.	Insoluble.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution of the salt yields, with test-solution of oxalate of ammonium, a white precipitate soluble in hydrochloric, but insoluble in acetic acid. Acidified with hydrochloric acid and added to excess of test-solution of mercuric chloride, it produces a white precipitate of mercurous chloride, and, on further addition, metallic mercury separates.	Insoluble Calcium Salts.	When dissolved in water, the salt should leave no insoluble residue.
	Soluble Phosphate.	The aqueous solution of the salt should yield no precipitate with test-solution of acetate of lead.
	Soluble Sulphate.	The aqueous solution of the salt, after being acidulated with nitric acid, should yield no precipitate with test-solution of chloride of barium.
	Magnesium.	On adding to the aqueous solution of the salt, first, chloride of ammonium, then test-solution of carbonate of ammonium and water of ammonia in slight excess, and gently warming, the filtrate separated from the resulting precipitate should not be rendered more than faintly turbid by test-solution of phosphate of sodium.

Uses.—Calcium hypophosphite is used pharmaceutically to prepare the other hypophosphites and hypophosphorous acid. Medicinally, it is used in phthisis and other wasting diseases, and in cases of defective nerve-nutrition. The dose is from ten to thirty grains.

SYRUPUS HYPOPHOSPHITUM. *U.S.* Syrup of Hypophosphites.

This syrup is made by dissolving thirty-five parts of calcium hypophosphite and twelve parts each of sodium and potassium hypophosphites in water, aiding the solution by the use of one part of citric acid. After the addition of two parts of spirit of lemon, the liquid is filtered and sufficient water and sugar are added to make one thousand parts of finished syrup (see page 264). There is usually a trifling residue left after dissolving the hypophosphites: this consists generally of insoluble calcium salts. Citric acid is used to dissolve the residue. The citric acid serves also to prevent precipitation in the finished syrup.

SYRUPUS HYPOPHOSPHITUM CUM FERRO. *U.S.* Syrup of Hypophosphites with Iron.

This preparation is made by dissolving one part of ferrous lactate in ninety-nine parts of syrup of hypophosphites. It is used, like the preceding syrup, in phthisis and other wasting diseases, under the belief that the hypophosphites stimulate defective nutrition.

CALCII PHOSPHAS PRÆCIPITATUS. *U.S.* Precipitated Phosphate of Calcium.

$Ca_3(PO_4)_2$; 310.

Preparation.—Take of Bone, calcined to whiteness, and in fine powder, 4 oz. troy; Hydrochloric Acid 8 oz. troy; Water of Ammonia 12 fl. oz., or a sufficient quantity; Distilled Water, a sufficient quantity. Macerate the Bone in the Acid, diluted with a pint of Distilled Water, until it is dissolved, and filter the solution. Add another pint of Distilled Water, and then, gradually, Water of Ammonia, until the liquid acquires an alkaline reaction. Mix the precipitate obtained, while yet

in the state of magma, with twice its bulk of boiling Distilled Water, and pour the whole upon a strainer. Wash the precipitate with boiling Distilled Water until the washings cease to be affected by a solution of nitrate of silver, acidulated with nitric acid. Lastly, dry the precipitate with a gentle heat.

Calcium phosphate exists in calcined bone: it is soluble in hydrochloric acid, but is precipitated from its solution by water of ammonia, ammonium chloride remaining in solution.

Calcii Phosphas Præcipitatus. *U.S.*	Odor and Taste.	Solubility.	
		Water.	Alcohol.
A light, white, amorphous powder, permanent in the air. At an intense heat it is fusible without decomposition.	Odorless; tasteless.	Insoluble.	Insoluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
A solution of the salt in diluted nitric acid, after being mixed with an excess of acetate of sodium, yields a white precipitate with test-solution of oxalate of ammonium, and a lemon-yellow precipitate with test-solution of ammonio-nitrate of silver.	Carbonate.	Wholly soluble in nitric or in hydrochloric acid without effervescence.
On dissolving 1 Gm. of the salt in hydrochloric acid, and subsequently adding water of ammonia, the salt is precipitated unaltered.	Aluminium.	The precipitate formed by adding water of ammonia to a solution of 1 Gm. of the salt in hydrochloric acid should yield nothing to a boiling solution of potassa.
When the above precipitate is washed and dried, it should weigh 1 Gm.		

Uses.—Precipitated phosphate of calcium, on account of its insolubility in water, has been used in making medicated waters in preference to magnesium carbonate and other similar substances. It is administered largely now in proprietary medicines, in combination with lactic acid and phosphoric acid, in cases of defective nutrition. The dose is from ten to thirty grains.

SYRUPUS CALCII LACTOPHOSPHATIS. *U.S.* **Syrup of Lactophosphate of Calcium.**

This syrup is made by dissolving precipitated phosphate of calcium in diluted hydrochloric acid, and precipitating the dissolved phosphate by the addition of water of ammonia. The washed magma is dissolved in lactic acid and water, and orange-flower water and sugar added to the solution to complete the syrup (see page 261 for the working formula). The object of the first part of the process is to obtain freshly precipitated calcium phosphate, because lactic acid will not dissolve the dried salt. It is sometimes made extemporaneously by dissolving 200 grains of calcium lactophosphate in one pint of syrup of orange flowers, which contains one fluidrachm of hydrochloric acid. It is given in doses of one to four teaspoonfuls.

PULVIS CRETÆ COMPOSITUS. *U.S.* **Compound Chalk Powder.**

The preparation is made by mixing thirty parts of prepared chalk with twenty parts of powdered acacia and fifty parts of powdered sugar. It is used for making chalk mixture (see Part VI.).

MISTURA CRETÆ. *U.S.* Chalk Mixture.

This mixture is made by rubbing twenty parts of compound chalk powder with forty parts each of water and cinnamon-water (see page 272).

TROCHISCI CRETÆ. *U.S.* Troches of Chalk.

Each troche contains four grains of prepared chalk, one grain of acacia, one-seventh of a grain of nutmeg, and six grains of sugar (see Part VI.).

Barium. Ba; 136.8.

Although this element furnishes no salt to the Materia Medica of the Pharmacopœia, two of its salts are used officinally in making test-solutions. *Barium* occurs abundantly as carbonate and sulphate. It is a malleable metal, having a silver-white lustre, decomposes water, and gradually oxidizes in the air.

Tests for Salts of Barium.

1. A soluble barium salt produces with sulphuric acid or soluble sulphate a white precipitate of barium sulphate, which is entirely insoluble in all acids.
2. Barium causes a colorless flame to be colored green.
3. Alkaline carbonates produce white precipitates with soluble barium salts, insoluble in excess.

Officinal Preparations of Barium.

Preparations.
Test-solution of Chloride of Barium.
Test-solution of Nitrate of Barium.

Unofficinal Salts of Barium.

Barii Acetas, $Ba(C_2H_3O_2)_2$, = 254.8. Acetate of Barium.	By decomposing barium carbonate with acetic acid, evaporating, then crystallizing.
Barii Benzoas, $Ba(C_7H_5O_2)_2 + 2H_2O$, = 414.8. Benzoate of Barium.	By adding to a solution of barium carbonate, benzoic acid until neutralised, then evaporating and crystallizing.
Barii Boras. Borate of Barium.	By adding to a solution of barium carbonate a solution of sodium borate, and collecting and drying the precipitate.
Barii Bromidum, $BaBr_2.2H_2O$, = 332.8. Bromide of Barium.	By saturating baryta water with hydrobromic acid, evaporating, then crystallizing.
Barii Chloridum, $BaCl_2.2H_2O$, = 243.6. Chloride of Barium. (See U.S. P. Test-Solution.)	By dissolving barium carbonate in hydrochloric acid, evaporating, then crystallizing.
Barii Chromas, $BaCrO_4$, = 253.2. Chromate of Barium.	By adding to a solution of potassium chromate, baryta water, and collecting and drying the precipitate.
Barii Citras, $Ba_3C_6H_5O_7$, = 599.4. Citrate of Barium.	By adding citric acid to baryta water in excess, and collecting the precipitate.
Barii Nitras, $Ba2NO_3$, = 260.8. Nitrate of Barium. (See U.S. P. Test-Solution.)	By adding to a solution of barium chloride a solution of sodium nitrate, and collecting and drying the precipitate.
Barii Oxalas, $BaC_2O_4.2H_2O$, = 260.8. Oxalate of Barium.	By adding a solution of oxalic acid to an excess of baryta water, and collecting the precipitate.
Barii Sulphas, $BaSO_4$, = 232.8. Sulphate of Barium.	By adding to a solution of barium chloride, sulphuric acid, and collecting the precipitate.

CHAPTER XLIII.

ZINC, ALUMINIUM, CERIUM, AND CADMIUM.

Zn; 64.9. Al; 27. Ce; 141. Cd; 111.8.

THESE metals are grouped together on account of the similarity in some of their physical properties, rather than because of the chemical analogies existing between them.

ZINCUM. *U.S.* Zinc.

Zn; 64.9.

Metallic Zinc, in the form of thin sheets, or irregular, granulated pieces.

Preparation.—Zinc is made by roasting *calamine*, or the impure carbonate of zinc, with charcoal, in powder, and collecting the zinc by distillation, the vapors being conducted into water, where the zinc is condensed. It is bivalent, and combines with oxygen, chlorine, and phosphorus, forming zinc oxide, chloride, and phosphide, and with numerous acids to form salts.

Tests for Zinc Salts.

1. Ammonium sulphide, if added to a solution of a zinc salt containing an excess of alkaline hydrate, produces a characteristic white precipitate of zinc sulphide.
2. The alkaline hydrates of either sodium, potassium, or ammonium produce white precipitates of zinc hydrate, freely soluble in an excess of alkali.
3. Sodium and potassium carbonates yield white precipitates, insoluble in an excess.
4. The zinc salts are all colorless.

Zincum. *U.S.*	Impurities.	Tests for Impurities.
A bluish-white metal. When treated with warm, diluted sulphuric acid, it is almost completely dissolved, forming a colorless liquid which yields a white precipitate with test-solution of ferrocyanide of potassium or of sulphide of ammonium.	Arsenic.	If the gas which is given off during the solution be made to come in contact with paper wet with test-solution of nitrate of silver, no brown or black stain should be produced on the paper.
	More than traces of Lead, Iron, and Copper.	On adding water of ammonia to a colorless solution of the metal in diluted sulphuric acid, a white precipitate is produced which should be soluble in an excess of water of ammonia, yielding a colorless liquid.

Uses.—Zinc is used in making hydrogen and in preparing the zinc salts.

Officinal Preparations of Zinc.

Officinal Name.	Preparation.
Zincum	Made by roasting the impure carbonate with charcoal and distilling.
Zinci Acetas	By treating zinc carbonate with acetic acid.
Zinci Bromidum	By double decomposition of zinc sulphate and potassium bromide.
Zinci Carbonas Præcipitatus	By double decomposition of zinc sulphate and sodium carbonate.
Zinci Chloridum	By evaporating the solution of zinc chloride.
Liquor Zinci Chloridi	By treating zinc with hydrochloric acid.
Zinci Iodidum	By digesting zinc with iodine diffused in water.
Zinci Oxidum	By calcining zinc carbonate.
Unguentum Zinci Oxidi	By incorporating zinc oxide with benzoinated lard.
Zinci Phosphidum	By passing vapors of phosphorus over fused zinc in a current of dry hydrogen.
Zinci Sulphas	By acting on zinc with diluted sulphuric acid.
Zinci Valerianas	By double decomposition of zinc sulphate and sodium valerianate.

Unofficinal Salts of Zinc.

Zinci Cyanidum, $Zn(CN)_2$, = 116.9. Cyanide of Zinc.	By adding hydrocyanic acid to a solution of zinc acetate and collecting the precipitate.
Zinci et Potassii Cyanidum, K_2ZnCy_4, = 246.9. Cyanide of Zinc and Potassium.	By dissolving zinc cyanide in a solution of pure potassium cyanide, filtering, concentrating, then crystallizing.
Zinci Ferrocyanidum, $Zn_4(C_3N_3)_4Fe_3$, = 683.4. Ferrocyanide of Zinc.	By making a solution of zinc sulphate and one of potassium ferrocyanide, mixing them, and collecting the precipitate.
Zinci Lactas, $Zn(C_3H_5O_3)_2.3H_2O$, = 296.9. Lactate of Zinc.	Dissolving, by the aid of heat, zinc carbonate in diluted lactic acid, filtering and concentrating, then crystallizing.
Zinci Salicylas, $Zn(C_7H_5O_3)_2.3H_2O$, = 392.9. Salicylate of Zinc.	By heating salicylic acid with distilled water, gradually adding zinc oxide suspended in water, until no longer dissolved, filtering, and then crystallizing.
Zinci Sulphocarbolas, $Zn(C_6H_5SO_4)_2$. $8H_2O$, = 554.9. Sulphocarbolate of Zinc.	By mixing concentrated solutions of barium sulphocarbolate and zinc carbonate and collecting the precipitate.
Zinci Tartras. Tartrate of Zinc.	By mixing hot concentrated solutions of zinc sulphate and neutral potassium tartrate, collecting the precipitate and drying it.

ZINCI ACETAS. *U. S.* Acetate of Zinc.

$Zn(C_2H_3O_2)_2.3H_2O$; 286.9.

Preparation.—This salt may be made by the former officinal process: Take of Commercial Oxide of Zinc 2 oz. troy; Acetic Acid 8½ fl. oz.; Distilled Water 5 fl. oz. Mix the Acid and Water, and digest the Oxide of Zinc in the mixture for half an hour, then heat to the boiling point, filter while hot, and set aside to crystallize. Drain the crystals in a funnel, and dry them upon bibulous paper. An additional quantity of crystals may be obtained by evaporating the mother-liquor to one-half, slightly acidulating with acetic acid, and crystallizing.

The reaction is expressed as follows:

$$\underset{\text{Zinc Oxide.}}{ZnO} + \underset{\text{Acetic Acid.}}{2HC_2H_3O_2} = \underset{\text{Zinc Acetate.}}{Zn(C_2H_3O_2)_2} + \underset{\text{Water.}}{H_2O}.$$

Zinci Acetas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Soft, white, micaceous or pearly, six-sided tablets or scales, somewhat efflorescent in dry air. When strongly heated, the salt melts, and at a higher temperature it is decomposed with evolution of acetous vapors, a residue of oxide of zinc being finally left.	Faintly acetous odor; sharp, metallic taste; slightly acid reaction.	Cold. 3 parts. Boiling. 1.5 parts.	Cold. 30 parts. Boiling. 3 parts.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution of the salt yields a white precipitate with test-solution of ferrocyanide of potassium or of sulphide of ammonium. On heating the salt with sulphuric acid, acetous vapors are evolved.	Lead or Copper.	The aqueous solution of the salt, acidulated with hydrochloric acid, should yield no dark-colored precipitate with hydrosulphuric acid.
	Iron, Aluminium, and most of the Alkaline Earths.	On adding test-solution of carbonate of ammonium to the aqueous solution, a white precipitate is produced which should be wholly soluble in an excess of the reagent.
	Salts of Alkalies or of Alkaline Earths.	On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate should leave no fixed residue on evaporation and gentle ignition.

Uses.—Acetate of zinc is used principally as a local remedy, in eye-washes, injections, etc.

ZINCI BROMIDUM. *U. S.* Bromide of Zinc.

$ZnBr_2$; 224.5.

Preparation.—Zinc bromide may be made by the process suggested by Lyons, of dissolving 100 grains of potassium bromide and 240 grains of crystallized sulphate of zinc, each, in the smallest quantity of hot water, and mixing while hot. When the mixture has cooled, twice its bulk of alcohol is added, and the whole filtered through asbestos to separate the potassium sulphate. The filtrate is evaporated to dryness, and the residue granulated.

This salt may also be made by adding bromine to water and dropping in *mossy zinc*, a form of metallic zinc made by pouring the pure melted metal in water (the pieces bear some resemblance to moss); zinc bromide remains in solution, and may be obtained by filtration, evaporation, and granulation.

$$\underset{\text{Zinc Sulphate.}}{ZnSO_4} + \underset{\text{Potassium Bromide.}}{2KBr} = \underset{\text{Zinc Bromide.}}{ZnBr_2} + \underset{\text{Potassium Sulphate.}}{K_2SO_4}.$$

Zinci Bromidum. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, or nearly white, granular powder, very deliquescent. When strongly heated, it fuses, and at a higher temperature it is volatilized with partial decomposition.	Odorless; sharp, saline, and metallic taste; neutral reaction.	Very soluble.	Very soluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution of the salt yields a white precipitate with test-solution of ferrocyanide of potassium or of sulphide of ammonium. On adding some disulphide of carbon to the aqueous solution, then chlorine water, drop by drop, and agitating, the disulphide will separate with a yellow to brownish-red color, free from violet tint.	Lead or Copper.	When acidulated with hydrochloric acid, the aqueous solution of the salt should yield no dark-colored precipitate with hydrosulphuric acid.
	Iron, Aluminium, and most of the Alkaline Earths.	On adding test-solution of carbonate of ammonium to the aqueous solution, a white precipitate is produced which should be wholly soluble in an excess of the reagent.
1 Gm. of the dry salt, when completely precipitated by nitrate of silver, yields 1.67 Gm. of dry bromide of silver.	Salts of Alkalies or of Alkaline Earths.	On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate should leave no fixed residue on evaporation and gentle ignition.

Uses.—Zinc bromide is used medicinally as a hypnotic, in doses of five grains.

ZINCI CARBONAS PRÆCIPITATUS. *U.S.* Precipitated Carbonate of Zinc.

$(ZnCO_3)_2.3Zn(HO)_2$; 546.5.

Preparation.—This salt may be made by the British process, as follows:

Take of Sulphate of Zinc 10 oz. av.; Carbonate of Soda 10½ oz. av.; Boiling Distilled Water a sufficiency. Dissolve the Carbonate of Soda with a pint [Imperial measure] of the Water in a capacious porcelain vessel, and pour into it the Sulphate of Zinc also dissolved in a pint [Imp. meas.] of the Water, stirring diligently. Boil for fifteen minutes after effervescence has ceased; and let the precipitate subside. Decant the supernatant liquor, pour on the precipitate 3 pints of boiling Distilled Water, agitating briskly; let the precipitate again subside; and repeat the process of effusion of hot Distilled Water and subsidence, till the washings are no longer precipitated by chloride of barium. Collect the precipitate on calico, let it drain, and dry it with a gentle heat.

$$\underset{\text{Sodium Carbonate.}}{5Na_2CO_3} + \underset{\text{Zinc Sulphate.}}{5ZnSO_4} + \underset{\text{Water.}}{3H_2O} = \underset{\text{Zinc Carbonate.}}{(ZnCO_3)_2 3Zn(HO)_2} + \underset{\text{Sodium Sulphate.}}{5Na_2SO_4} + \underset{\text{Carbon Dioxide.}}{3CO_2}.$$

If cold solutions of zinc sulphate and sodium carbonate are mixed together, neutral zinc carbonate is precipitated. This carbonate quickly decomposes, carbon dioxide being evolved, which, upon escaping, makes a portion of the precipitate soluble. This loss is prevented by conducting the precipitation at the boiling temperature, whereby the carbon dioxide is driven off as quickly as it is formed, and solution thereby prevented.

Zinci Carbonas Præcipitatus. *U.S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A white, impalpable powder, permanent in the air. When strongly heated, the salt loses water and carbonic acid gas, and leaves a residue of oxide of zinc.	Odorless; tasteless.	Insoluble.	Insoluble.	Soluble in acids with copious effervescence.

Tests for Identity.	Impurities.	Tests for Impurities.
On dissolving the salt to saturation in diluted sulphuric acid, a portion of the filtrate, when mixed with test-solution of ferrocyanide of potassium or of sulphide of ammonium, yields a white precipitate.	Lead or Copper.	On dissolving the salt in diluted sulphuric acid, the filtrate, acidulated with hydrochloric acid, should not yield a dark-colored precipitate with hydrosulphuric acid.
	Iron, Aluminium, and most of the Alkaline Earths.	On dissolving the salt in diluted sulphuric acid, the filtrate, with test-solution of carbonate of ammonium, yields a white precipitate which should be wholly soluble in an excess of the reagent.
	Salts of Alkalies or of Alkaline Earths.	On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate should not leave more than a trifling, fixed residue on evaporation and gentle ignition.

Uses.—Precipitated carbonate of zinc is used principally in ointments, and takes the place of the former impure carbonate termed *calamine*. It is sometimes dusted upon inflamed surfaces as an astringent and absorbent.

ZINCI CHLORIDUM. *U.S.* Chloride of Zinc.

$ZnCl_2$; 135.7.

Preparation.—Zinc chloride is easily prepared by digesting metallic zinc in hydrochloric acid and evaporating the solution to dryness; or, preferably, by evaporating the officinal solution of chloride of zinc.

$$\underset{\text{Zinc.}}{2Zn} + \underset{\text{Hydrochloric Acid.}}{4HCl} = \underset{\text{Zinc Chloride.}}{2ZnCl_2} + \underset{\text{Hydrogen.}}{4H}.$$

Zinci Chloridum. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, crystalline powder, or white, opaque pieces, very deliquescent. When heated to about 115° C. (239° F.), the salt melts, yielding a clear liquid, which, on cooling, congeals to a white or grayish-white solid. At a higher temperature it is partially volatilized and decomposed.	Odorless; very caustic, saline, and metallic taste; acid reaction.	Very soluble, forming a clear or only faintly opalescent liquid. The opalescence is removed by the addition of a few drops of hydrochloric acid.	Very soluble, forming a clear or only faintly opalescent liquid. The opalescence is removed by the addition of a few drops of hydrochloric acid.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution yields a white precipitate with test-solution of ferrocyanide of potassium, or of sulphide of ammonium, or of nitrate of silver.	Basic Salt.	The aqueous solution of the salt should be miscible with alcohol without precipitation.
	Lead or Copper.	When aqueous solution of the salt is acidulated with hydrochloric acid, it should yield no dark-colored precipitate with hydrosulphuric acid.
	Iron, Aluminium, and most of the Alkaline Earths.	On adding test-solution of carbonate of ammonium to the aqueous solution, a white precipitate is produced which should be wholly soluble in an excess of the reagent.
	Salts of Alkalies or of Alkaline Earths.	On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate should leave no fixed residue on evaporation and gentle ignition.

Uses.—Zinc chloride in solution is used as an antiseptic and disinfectant (see Liquor Zinci Chloridi, below). Externally, mixed with flour and water, it is used as an escharotic.

LIQUOR ZINCI CHLORIDI. *U.S.* Solution of Chloride of Zinc.

An aqueous solution of Chloride of Zinc [$ZnCl_2$; 135.7], containing about 50 per cent. of the salt.

	By measure.
Zinc, granulated, 240 parts, or	6¼ oz. av.
Nitric Acid, 12 parts, or	100 minims.
Precipitated Carbonate of Zinc, 12 parts, or	136 grains.
Hydrochloric Acid,	
Distilled Water, each, a sufficient quantity,	
To make 1000 parts, or	1 pint.

To the Zinc, contained in a glass or porcelain vessel, add, gradually, enough Hydrochloric Acid to dissolve it; then strain the solution, add the Nitric Acid, evaporate to dryness, and bring the dry mass to fusion. Let it cool, dissolve it in *one hundred and fifty parts* [or 4½ fl. oz.] of Distilled Water, add the Precipitated Carbonate of Zinc, and agitate the mixture occasionally during twenty-four hours. Finally, filter through white filtering paper free from iron, and pass enough Distilled Water through the filter to make the solution weigh *one thousand parts* [or measure 1 pint].

When zinc is treated with hydrochloric acid, hydrogen is evolved and zinc chloride is produced.

$$\underset{\text{Zinc.}}{2Zn} + \underset{\substack{\text{Hydrochloric}\\\text{Acid.}}}{4HCl} = \underset{\substack{\text{Zinc}\\\text{Chloride.}}}{2ZnCl_2} + \underset{\text{Hydrogen.}}{4H}.$$

Zinc is almost invariably contaminated with iron, and more or less ferrous chloride is present in the first solution. Nitric acid is added, and the solution is evaporated to dryness. The iron salt is thus oxidized, and it is then precipitated by the addition of zinc carbonate, the insoluble ferric hydrate and carbonate, with any excess of zinc carbonate, being filtered out.

Solution of chloride of zinc is a clear, colorless liquid, odorless, having a very astringent, sweetish taste, and an acid reaction. Sp. gr. 1.555. (See Zinci Chloridum, page 537, for the tests.)

Uses.—This solution, sometimes called *Burnett's disinfecting fluid*, is used principally as an antiseptic and disinfectant. Among its advantages, absence of odor is one of the most prominent.

ZINCI IODIDUM. *U.S.* Iodide of Zinc.

ZnI_2; 318.1.

Preparation.—Zinc iodide may be formed by digesting an excess of zinc with iodine diffused in water, in a manner similar to that used in making the corresponding iron salt.

$$\underset{\text{Zinc.}}{Zn} + \underset{\substack{\text{Hydriodic}\\\text{Acid.}}}{2HI} = \underset{\substack{\text{Zinc}\\\text{Iodide.}}}{ZnI_2} + \underset{\text{Hydrogen.}}{2H}.$$

Zinci Iodidum. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, or nearly white, granular powder, very deliquescent. When strongly heated, it melts, and at a higher temperature it is volatilised with partial decomposition.	Odorless; sharp, saline, and metallic taste; acid reaction.	Very soluble.	Very soluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution yields a white precipitate with test-solution of ferrocyanide of potassium or of sulphide of ammonium, a yellow precipitate with test-solution of acetate of lead, and a red one with test-solution of mercuric chloride.	Lead or Copper.	The aqueous solution of the salt, when acidulated with hydrochloric acid, should yield no dark-colored precipitate with hydrosulphuric acid.
1 Gm. of the dry salt, when completely precipitated with nitrate of silver, yields 1.47 Gm. of dry iodide of silver.	Iron, Aluminium, and most of the Alkaline Earths.	On adding test-solution of carbonate of ammonium to the aqueous solution, a white precipitate is produced which should be wholly soluble in an excess of the reagent.
	Salts of Alkalies or of Alkaline Earths.	On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate should leave no fixed residue on evaporation and gentle ignition.

Uses.—Iodide of zinc is used as an alterative, in doses of one-half grain to two grains.

ZINCI OXIDUM. *U. S.* Oxide of Zinc.

ZnO; 80.9.

Preparation.—Zinc oxide may be prepared by the former officinal process, as follows:

Take of Precipitated Carbonate of Zinc 12 oz. troy. Expose it, in a shallow vessel, to a low red heat until the water and carbonic acid are wholly expelled.

Commercial oxide of zinc is made on the large scale by heating calamine and coal ground together, roasting in a furnace of peculiar construction, and separating the impurities by blowing the mixed vapors up a large tower, allowing the heavier particles to subside in the tower, and then by a powerful draught blowing the zinc oxide into a room containing muslin bags, when the oxide is deposited.

Zinci Oxidum. *U. S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A soft, pale yellowish, nearly white powder, permanent in the air. When strongly heated, the Oxide assumes a deep lemon-yellow color, but turns nearly white again on cooling.	Odorless; tasteless.	Insoluble.	Insoluble.	Soluble in acids without effervescence.

Tests for Identity.	Impurities.	Tests for Impurities.
On dissolving the Oxide, to saturation, in diluted sulphuric acid and filtering, a portion of the filtrate, when mixed with test-solution of ferrocyanide of potassium or sulphide of ammonium, yields a white precipitate.	Carbonate.	The salt is soluble in acids without effervescence.
	Lead or Copper.	On dissolving the Oxide, to saturation, in diluted sulphuric acid and filtering, the filtrate, acidulated with hydrochloric acid, should yield no dark-colored precipitate with hydrosulphuric acid.
	Iron, Aluminium, and most of the Alkaline Earths.	On dissolving the Oxide, to saturation, in diluted sulphuric acid and filtering, the filtrate, mixed with test-solution of carbonate of ammonium, yields a white precipitate which should be wholly soluble in an excess of the reagent.
	Salts of Alkalies or of Alkaline Earths.	On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate should not leave more than a trifling, fixed residue on evaporation.

Commercial oxide of zinc will not usually conform to the officinal tests: it is generally very white and filled with hard lumps, which are difficult to reduce to powder. The officinal powder has a decided cream tint, and can be mixed with ointment so that a smooth preparation is easily made without trituration. (See Unguentum Zinci Oxidi.)

Uses.—Zinc oxide is rarely used internally; externally, it is used as an exsiccant to inflamed surfaces, and it may be dusted on the part or used in the form of an ointment.

UNGUENTUM ZINCI OXIDI. *U.S.* Oxide of Zinc Ointment.

Made by incorporating twenty parts of zinc oxide with eighty parts of benzoinated lard.

ZINCI PHOSPHIDUM. *U.S.* Phosphide of Zinc.

Zn_3P_2; 256.7.

Preparation.—Zinc phosphide is made by passing vapors of phosphorus in a current of dry hydrogen over fused zinc. The product is a spongy, gray mass, of metallic appearance, containing rhomboidal crystals, and when powdered somewhat resembling reduced iron. The metallic particles of zinc should be separated. It is a heavy powder, its sp. gr. being 4.72.

Zinci Phosphidum. *U.S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Minutely crystalline, friable fragments, having a metallic lustre on the fractured surfaces, or a grayish-black powder, permanent in the air. When strongly heated, with exclusion of air, the salt melts and is completely volatilized. If heated for some time in the air, it is partially converted into phosphate of zinc.	Faint odor and taste of phosphorus.	Insoluble.	Insoluble.	Completely soluble in hydrochloric or sulphuric acid with evolution of phosphoretted hydrogen.

Tests for Identity.	Impurities.	Test for Impurities.
On dissolving the salt, to saturation, in diluted sulphuric acid, and driving off the phosphoretted hydrogen by heat, a portion of the cold filtrate, when mixed with test-solution of ferrocyanide of potassium or of sulphide of ammonium, yields a white precipitate.	Lead or Copper.	On dissolving the salt, to saturation, in diluted sulphuric acid, and driving off the phosphoretted hydrogen by heat, the filtrate, acidulated with hydrochloric acid, should not yield a dark-colored precipitate with hydrosulphuric acid.

Uses.—Zinc phosphide is used as a nervous stimulant and aphrodisiac: it is frequently preferred to phosphorus for these purposes. The dose is one-twentieth to one-eighth of a grain.

ZINCI SULPHAS. *U. S.* Sulphate of Zinc.

$ZnSO_4.7H_2O$; 286.9.

Preparation.—Zinc sulphate is made by acting on metallic zinc with diluted sulphuric acid, hydrogen being evolved; the resulting solution is freed from the contamination of iron by first passing chlorine into it, when ferric chloride is produced, and, upon the addition of zinc carbonate, decomposition takes place, ferric hydrate separating as an insoluble precipitate, which is removed by filtration, and a small quantity of zinc chloride is formed, which, being very soluble, remains in the mother-liquor after the crystallization of the sulphate.

$$\underset{\text{Zinc.}}{2Zn} + \underset{\text{Sulphuric Acid.}}{2H_2SO_4} + \underset{\text{Water.}}{H_2O} = \underset{\text{Zinc Sulphate.}}{2ZnSO_4} + \underset{\text{Hydrogen.}}{4H} + \underset{\text{Water.}}{H_2O}.$$

Zinci Sulphas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Small, colorless, right-rhombic prisms, or acicular needles, slowly efflorescing in dry air. When strongly heated, the salt melts, gradually loses water, and at a higher temperature it is decomposed with evolution of sulphurous vapors.	Odorless; sharp, saline, nauseous, and metallic taste; acid reaction.	Cold. 0.6 part. Boiling. 0.3 part.	Insoluble.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution of the salt yields a white precipitate with test-solution of ferrocyanide of potassium, or of sulphide of ammonium, or of chloride of barium.	Chloride.	A 1 per cent. aqueous solution of the salt, acidulated with nitric acid, should not be rendered turbid by test-solution of nitrate of silver.
	Lead or Copper.	The aqueous solution, acidulated with hydrochloric acid, should yield no dark-colored precipitate with hydrosulphuric acid.
	Iron, Aluminium, and most of the Alkaline Earths.	On adding test-solution of carbonate of ammonium to an aqueous solution of the salt, a white precipitate is produced which should be wholly soluble in an excess of the reagent.
	Salts of Alkalies or of Alkaline Earths.	On completely precipitating the zinc from this alkaline solution by sulphide of ammonium, the filtrate should leave no fixed residue on evaporation and gentle ignition.

Uses.—This salt is the most important of those made from zinc. It is used medicinally as a prompt and certain emetic in doses of ten to thirty grains; as a tonic and astringent, one to two grains.

ZINCI VALERIANAS. *U. S.* Valerianate of Zinc.

$Zn(C_5H_9O_2)_2.H_2O$; 284.9.

Preparation.—The process for making this salt affords an illustration of the rather rare operation of "upward precipitation," the crystals of zinc valerianate being lighter than the mixed solutions:

Take of Valerianate of Soda 2½ oz. troy; Sulphate of Zinc 2 oz. troy, 420 grains; Distilled Water, a sufficient quantity. Dissolve the salts separately, each in 20 fluidounces of Distilled Water, and, having heated the solutions to 100° C. (212° F.), mix them, and set the mixture aside to crystallize. Decant the mother-water from the crystals, and put them upon a filter in a funnel to drain. Mix the mother-water and the drainings, evaporate at a heat not exceeding 93.3° C. (200° F.) to 4 fluidounces, and again set aside to crystallize. Add the crystals, thus obtained, to those in the funnel, wash the whole with a little Distilled Water, and, having removed them with the filter, spread them on bibulous paper, and dry them with a heat not exceeding 93.3° C. (200° F.).

$$2NaC_5H_9O_2 + ZnSO_4 = Zn(C_5H_9O_2)_2 + Na_2SO_4.$$

Sodium Valerianate. Zinc Sulphate. Zinc Valerianate. Sodium Sulphate.

Zinci Valerianas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Soft, white, pearly scales, permanent in the air. When heated, the salt melts; at a higher temperature it gives off white, inflammable vapors, and finally leaves a residue of oxide of zinc.	Faint odor of valerianic acid; sweet, afterwards styptic and metallic taste; acid reaction.	100 parts, becoming turbid on boiling.	40 parts, becoming turbid on boiling.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The salt is completely dissolved by an excess of water of ammonia, and, on adding test-solution of sulphide of ammonium, a white precipitate is produced. On moistening 1 Gm. of the salt with nitric acid, evaporating to dryness, again moistening with nitric acid, drying, and igniting, a residue will be left which should weigh 0.283 Gm.	Salts of Alkalies and Alkaline Earths.	The salt is completely dissolved by an excess of water of ammonia, and, on adding test-solution of sulphide of ammonium to this solution, a white precipitate is produced. The filtrate should leave no residue on evaporation.
	Butyrate.	On mixing a cold, concentrated solution of the salt and a similar one of acetate of copper, no turbidity or precipitate should be produced in the mixture.

Uses.—Valerianate of zinc is used as a nervine and antispasmodic, in doses of one to three grains.

Aluminium. Al; 27.

This metal is found largely in combination with silicic acid, in the rocks and clays forming a great portion of the earth's surface. Some of the precious stones and valuable minerals are compounds of alumin-

ium; the ruby and sapphire, corundum and emery, are crystallized forms of aluminium oxide. Aluminium is of a silver-white color. The metal, owing to improvements in its extraction, is much cheaper than it was formerly, and it is used in making ornamental and useful articles. Owing to its very low specific gravity (2.67), it is used for grain weights, because they are much larger, and thus more easily handled, than they would be if made from brass (see page 57). Aluminium forms but one class of compounds, in which it is trivalent. The oxides and sulphates unite with those of the alkali metals and form double salts called *alums*.

Tests for Salts of Aluminium.

1. Potassium or sodium hydrate produces white, gelatinous precipitates of aluminium hydrate in solutions of alum, which are freely soluble in excess of the alkali.
2. Water of ammonia produces a similar precipitate, insoluble in excess.
3. The alkaline carbonates precipitate the hydrate, carbon dioxide being evolved.
4. Ammonium sulphide also precipitates the hydrate, sulphuretted hydrogen being evolved.

Officinal Preparations of Aluminium.

Officinal Name.	Preparation.
Alumen	By treating alum-clay with sulphuric acid and potassium sulphate.
Alumen Exsiccatum	By heating alum to a temperature of 205° C. (401° F.).
Aluminii Hydras	By double decomposition of alum and sodium carbonate.
Aluminii Sulphas	By treating aluminium hydrate with sulphuric acid and crystallizing.

Unofficinal Preparations of Aluminium.

Aluminii Acetas, $Al_2 6C_2H_3O_2$, = 408. Acetate of Aluminium.	By dissolving aluminium hydrate in cold acetic acid, filtering and concentrating, then crystallizing.
Aluminii Bromidum, Al_2Br_6, = 532.8. Bromide of Aluminium.	By passing the vapor of bromine over a heated mixture of alumina and carbon.
Aluminii Chloridum, Al_2Cl_6, = 266.4. Chloride of Aluminium.	By dissolving aluminium hydrate in hydrochloric acid and evaporating carefully, then crystallizing.
Aluminii Iodidum, Al_2I_6, = 813.6. Iodide of Aluminium.	By heating aluminium and iodine together in closed tubes and collecting the crystals.
Aluminii Nitras, $Al_2(NO_3)_6.18H_2O$, = 750. Nitrate of Aluminium.	By dissolving aluminium hydrate in nitric acid, filtering and concentrating, then crystallizing.
Aluminii Oxidum, Al_2O_3, = 102. Oxide of Aluminium.	Occurs in nature.
Aluminii Phosphas, $Al_2(PO_4)_2$, = 244. Phosphate of Aluminium.	By adding a neutral solution of alumina to a solution of sodium phosphate, and collecting the gelatinous precipitate.

ALUMEN. *U.S.* Alum.

[Aluminii et Potassii Sulphas. Pharm. 1870. Potassa-alum.]

$K_2Al_2(SO_4)_4,24H_2O$; 948.

Preparation.—This valuable salt is made principally from alum-clay, which is chiefly aluminium silicate, by treating it with sulphuric acid, thereby forming aluminium sulphate. Potassium sulphate is then added, when the double salt $K_2Al_2(SO_4)_4$ is produced. It crystallizes with twenty-four molecules of water. Ammonia-alum, $(NH_4)_2Al_2(SO_4)_4$, is generally found in the market, because of its greater cheapness.

Alumen. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Large, colorless, octahedral crystals, sometimes modified by cubes, acquiring a whitish coating on exposure to air. When gradually heated, the salt loses water; at 92° C. (197.6° F.) it melts, and if heat be gradually increased to 200° C. (392° F.), it loses 45.57 per cent. of its weight (water of crystallization), leaving a bulky, white residue.	Odorless; sweetish, astringent taste; acid reaction.	Cold. 10.5 parts. Boiling. 0.3 part.	Insoluble.

Tests for Identity.	Impurities.	Tests for Impurities.
With solution of potassa or of soda, Alum yields a white precipitate which is completely soluble in an excess of the alkali, no odor of ammonia being evolved (difference from, and absence of, ammonia-alum. The aqueous solution of the salt dissolves zinc and iron with evolution of hydrogen. Water of ammonia produces a bulky, white precipitate, which is nearly insoluble in an excess of ammonia.	Zinc or Lead.	The clear alkaline solution of Alum should yield no precipitate with test-solution of sulphide of ammonium.
	Iron.	A solution of 1 Gm. of Alum in 30 C.c. of water should not assume more than a bluish coloration on the addition of a drop of test-solution of ferrocyanide of potassium.

Uses.—Alum is a powerful astringent. When powdered, it is used as an emetic in croup, in doses of a teaspoonful. It is sometimes used as a local styptic, and is frequently employed in making astringent lotions and injections.

ALUMEN EXSICCATUM. *U.S.* Dried Alum.

$K_2Al_2(SO_4)_4$; 516.

Alum, in small pieces, 184 parts, or	30 oz. av.
To make 100 parts, or	16 oz. av.

Expose the Alum for several days to a temperature of about 80° C. (176° F.), until it has thoroughly effloresced. Then place it in a porcelain capsule, and gradually heat it to a temperature of 200° C. (392° F.), being careful not to allow the heat to rise above 205° C. (401° F.). Continue heating at the before-mentioned temperature until the mass becomes white and porous, and weighs *one hundred parts* [or 16 oz. av.]. When cold, reduce it to a fine powder, and preserve it in well-stopped vessels.

This preparation represents alum nearly deprived of its water of crystallization: the latter exists in alum in the enormous proportion of nearly 45 per cent., thus constituting almost half of its weight.

Dried alum is officinally described as a white, granular powder, attracting moisture when exposed to the air, odorless, having a sweetish, astringent taste, very slowly but completely soluble in 20 parts of water at 15° C. (59° F.), and quickly soluble in 0.7 part of boiling water. It answers to the same reactions as Alum. (See Alumen.) Before pulverization, it is a light, white, opaque, porous mass.

Uses.—It is used as an escharotic. It is more powerful than alum, although not so soluble.

ALUMINII HYDRAS. *U.S.* **Hydrate of Aluminium. (Hydrated Alumina.)**

$Al_2(HO)_6$; 156.

Alum, 11 parts, or	**16 oz. av.**
Carbonate of Sodium, 10 parts, or	**14 oz. av.**
Distilled Water, a sufficient quantity.	

Dissolve each salt in *one hundred and fifty parts* [or 15 pints] of Distilled Water, filter the solutions and heat them to boiling. Then, having poured the hot solution of Carbonate of Sodium into a capacious vessel, gradually pour in the hot solution of Alum with constant stirring, and add about *one hundred parts* [or 10 pints] of boiling Distilled Water. Let the precipitate subside, decant the clear liquid, and pour upon the precipitate *two hundred parts* [or 20 pints] of hot Distilled Water. Again decant, transfer the precipitate to a strainer, and wash it with hot Distilled Water until the washings give but a faint cloudiness with test-solution of chloride of barium. Then allow it to drain, dry it with a heat not exceeding 40° C. (104° F.), and reduce it to a uniform powder.

$$\underset{\text{Potassa-Alum.}}{K_2Al_2(SO_4)_4} + 3\underset{\text{Sodium Carbonate.}}{Na_2CO_3} + 3\underset{\text{Water.}}{H_2O} = \underset{\text{Aluminium Hydrate.}}{Al_2(HO)_6} + \underset{\text{Potassium Sulphate.}}{K_2SO_4} + 3\underset{\text{Sodium Sulphate.}}{Na_2SO_4} + 3\underset{\text{Carbon Dioxide.}}{CO_2}.$$

The direction to add the alum solution to that of the sodium carbonate is important. If the mixing of the solution is reversed, the precipitated hydrate will be contaminated with the alkaline sulphates, so that it will be much more difficult to separate them.

Aluminii Hydras. *U.S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A white, light, amorphous powder, permanent in dry air. When heated to redness, it loses 34.6 per cent. of its weight (water of hydration).	Odorless; tasteless.	Insoluble.	Insoluble.	Soluble without residue in hydrochloric or sulphuric acid; also in solution of potassa or of soda.

Impurities.	Tests for Impurities.
Iron.	A solution of 1 Gm. of Hydrate of Aluminium in 30 C.c. of diluted hydrochloric acid should not be colored blue by a drop of test-solution of ferrocyanide of potassium.
Sulphate.	A solution of 1 Gm. of Hydrate of Aluminium in 30 C.c. of diluted hydrochloric acid should not give more than a faint cloudiness with test-solution of chloride of barium.
Zinc or Lead.	When Hydrate of Aluminium is dissolved in solution of potassa or of soda, it should yield no precipitate with test-solution of sulphide of ammonium.
Salts of Alkalies.	When Hydrate of Aluminium is boiled with 20 parts of water, and filtered, the filtrate should leave not more than a slight residue on evaporation.

Uses.—Hydrated alumina is a desiccant powder: it is absorbent and antacid. The dose is from two to five grains. Externally, it is used like zinc oxide, by dusting on the inflamed surface.

ALUMINII SULPHAS. *U. S.* Sulphate of Aluminium

$Al_2(SO_4)_3.18H_2O$; 666.

Preparation.—This sulphate may be made by the process formerly officinal:

Take of Alum, Carbonate of Sodium, each, 4 oz. troy; Sulphuric Acid 1 oz. troy 150 gr.; Water a sufficient quantity. Dissolve the salts separately, each in 6 fluidounces of boiling water, and pour the solution of the Alum gradually into that of the Carbonate of Sodium; then digest with a gentle heat until the evolution of carbonic acid ceases. Collect upon a filter the precipitate formed, and wash it with water, until the washings are no longer affected by chloride of barium. Next, with the aid of heat, dissolve the precipitate in the Sulphuric Acid, previously diluted with ½ pint of Water, and, having filtered the solution, evaporate it until a pellicle begins to form. Then remove it to a water-bath, and continue the evaporation, with constant stirring, until a dry salt remains. Lastly, preserve this in a well-stopped bottle.

Or the hydrate obtained by the process just noted (page 545) may be dissolved in diluted sulphuric acid, the solution evaporated, and the salt granulated.

Aluminii Sulphas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white, crystalline powder, permanent in the air. When heated, the salt melts in its water of crystallization, and at or near 200° C. (392° F.) it loses the whole of it, amounting to 48.6 per cent. of its weight.	Odorless; sweetish and afterwards astringent taste; acid reaction.	Cold. 1.2 parts, with a trifling residue. Boiling. Very soluble.	Almost insoluble.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution of the salt yields, with water of ammonia, a white, gelatinous precipitate, soluble in solution of potassa or of soda, and, with test-solution of chloride of barium, a white precipitate insoluble in hydrochloric acid.	Iron.	A solution of 1 Gm. of the salt in 30 C.c. of water should not give more than a faint blue coloration with a drop of test-solution of ferrocyanide of potassium.
	More than 5 per cent. of Sulphates of Alkalies.	If 1 Gm. of the salt be dissolved in 50 C.c. of water, a slight excess of water of ammonia added, the liquid heated until all odor of ammonia has disappeared, and then filtered, the precipitate well washed with water, and the filtrate and washings evaporated to dryness and gently ignited, the residue should not weigh more than 0.05 Gm.

Uses.—Aluminium sulphate is antiseptic: it is rarely used internally.

Cerium. Ce; 141.

Cerium is a metal occurring in *cerite*, *gadolinite*, etc.; it is of a chocolate-brown color, in masses; it takes fire more easily than magnesium; at ordinary temperatures it oxidizes in a moist atmosphere. Two oxides of cerium are known, Ce_2O_3, *cerous oxide*, and CeO_2, *ceric oxide*.

Test for Cerium Compounds.

If sodium hypochlorite be added to a solution of a colorless cerous salt, a red precipitate separates: this dissolves in warm hydrochloric acid, and evolves chlorine.

Officinal Preparation of Cerium.

Officinal Name.	Preparation.
Cerii Oxalas	By precipitating cerium chloride with oxalic acid.

Unofficinal Preparations of Cerium.

Ceroso-cerii Oxidum, Ce_3O_4, = 487. Ceroso-ceric Oxide.	By igniting cerium oxalate in an open vessel and then collecting the mass.
Cerii Chloridum, $CeCl_3$, = 211.8. Chloride of Cerium.	By burning cerium in chlorine gas and collecting the mass.
Cerii Nitras, $CeNO_3.2H_2O$, = 239. Nitrate of Cerium.	By dissolving ceroso-ceric oxide in nitric acid in presence of alcohol or some other reducing substance.
Cerii Oxidum, CeO, = 157. Oxide of Cerium.	By heating cerium oxalate in a current of dry hydrogen perfectly free from air.
Cerii Sulphas, $Ce_2(SO_4)_3$, = 570. Sulphate of Cerium.	By dissolving ceric oxide in sulphuric acid and evaporating, then crystallizing.

CERII OXALAS. *U. S.* Oxalate of Cerium.

$Ce_2(C_2O_4)_3.9H_2O$; 708.

Preparation.—This salt is made by decomposing the silicates in the powdered mineral containing the metal, with strong sulphuric acid, then heating the mass, and subsequently treating it with nitric and hydrosulphuric acids to separate contaminating metals. Hydrochloric acid is now added in small quantity, and the cerium compounds are precipitated by oxalic acid. This oxalate is impure, containing lanthanum and didymium compounds: it is therefore mixed with magnesium carbonate, and the mixture heated to redness to decompose the oxalates; the residue is dissolved in a small quantity of nitric acid, and the solution added to water containing a little sulphuric acid; ceric sulphate is produced, which is dissolved in sulphuric acid, and sodium hyposulphite added to reduce it to cerous sulphate; this is collected and treated with oxalic acid, when cerium oxalate precipitates. The complication in the method of preparation of this salt is due to the presence of the two rare metals didymium and lanthanum, which can be separated only with difficulty.

Cerii Oxalas. *U. S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A white, slightly granular powder, permanent in the air. On heating the salt to a dull red heat, a yellow or yellowish-red residue of oxide of cerium is left (a brown color would indicate the presence of oxide of didymium).	Odorless; tasteless.	Insoluble.	Insoluble.	Soluble in hydrochloric acid.

Tests for Identity.	Impurities.	Tests for Impurities.
On boiling the salt with solution of potassa, filtering, supersaturating a portion of the cold filtrate with acetic acid, and adding test-solution of chloride of calcium, a white precipitate is obtained, soluble in hydrochloric acid.	Aluminium.	A portion of the filtrate, obtained by boiling the salt with solution of potassa, should not yield a precipitate on the addition of an excess of test-solution of chloride of ammonium.
	Zinc.	A portion of the filtrate, obtained by boiling the salt with solution of potassa, should not yield a precipitate on the addition of test-solution of sulphide of ammonium.
	Carbonate, Metallic Impurities.	On dissolving the salt in hydrochloric acid, no effervescence should occur, and the solution should not be precipitated or rendered turbid by hydrosulphuric acid.

Uses.—Oxalate of cerium is a valuable remedy in controlling nausea. It is given in doses of two to ten grains.

Cadmium. Cd; 111.8.

This metal is associated with zinc in its ores. Although it enters into *no officinal preparations*, it is used to some extent in medicine, and hence merits a notice here. It is a white metal, resembling tin, but somewhat heavier and more tenacious. Like that metal, it crackles when bent. Its sp. gr. is 8.7. It is little affected by the air, but, when heated, combines with an atom of oxygen, forming a reddish brown or orange-colored oxide, CdO. Cadmium combines with chlorine, iodine, bromine, and sulphur.

Tests for Cadmium Salts.

1. Hydrosulphuric acid and ammonium sulphide produce precipitates of a yellow color (sulphide) when added to solutions of cadmium salts.
2. Sodium or potassium hydrate produces, with cadmium salts, white precipitates (hydroxide), insoluble in excess. Water of ammonia produces similar precipitates soluble in excess.
3. Sodium or potassium carbonate produces white precipitates of cadmium carbonate, insoluble in excess.

Unofficinal Compounds of Cadmium.

Cadmii Bromidum, $CdBr_2$, = 271.4. Bromide of Cadmium.	By double decomposition between potassium bromide and cadmium sulphate.
Cadmii Chloridum, $CdCl_2$, = 182.6. Chloride of Cadmium.	By treating cadmium or cadmium carbonate with hydrochloric acid.
Cadmii Iodidum, CdI_2, = 365. Iodide of Cadmium.	By double decomposition between potassium iodide and cadmium sulphate.
Cadmii Oxidum, CdO, = 127.8. Oxide of Cadmium.	By igniting cadmium nitrate or carbonate.
Cadmii Sulphidum, CdS, = 143.8. Sulphide of Cadmium.	By passing hydrosulphuric acid through a solution of cadmium chloride, nitrate, or sulphate.
Cadmii Sulphas, $CdSO_4.4H_2O$ = 279.8. Sulphate of Cadmium.	By treating cadmium carbonate or oxide with diluted sulphuric acid.

CHAPTER XLIV.

MANGANESE, IRON, AND CHROMIUM.

Mn; 54. Fe; 55.9. Cr; 52.4.

THESE three metals form a group exhibiting some chemical and physical analogies. They unite with oxygen, producing basic oxides.

Manganese. Mn; 54.

Manganese is found, as a mineral, quite extensively in the state of black oxide, as *pyrolusite*, *braunite*, and *hausmannite*. The carbonate also is sometimes found. The metal is very hard and brittle; when powdered, decomposing water readily. With oxygen it forms five—possibly seven—compounds. The *monoxide*, MnO, is of a light green color, and is the oxide present in or corresponding to manganous salts. The *sesquioxide*, Mn_2O_3, is black or dark brown, when in the hydrated state; the magnetic oxide, Mn_3O_4, is red; the dioxide, MnO_2, is black; and the permanganic oxide, Mn_2O_7, is, when in the free state, a very unstable dark reddish-brown liquid. The monoxide is a stable base, the sesquioxide feebly basic, and the dioxide when acted upon by acids yields manganous salts, while oxygen is evolved. The highest oxide is acid-forming, yielding permanganic acid, $HMnO_4$, the salts of which are known as permanganates. (See Potassii Permanganas, p. 463.) There exists also an acid, H_2MnO_4 (manganic), of which the salts formed are called manganates. The corresponding oxide, however, is not known.

Tests for Salts of Manganese.

1. Ammonium sulphide, added to a solution of a manganese salt, produces a flesh-colored precipitate of manganese sulphide.
2. Potassium or sodium carbonate in solution produces white precipitates, which are insoluble in excess of solution of ammonium carbonate.
3. With the blow-pipe, manganese gives with borax a bead having an amethystine color in the oxidizing flame, and a colorless bead in the deoxidizing flame.
4. If manganese be heated with sodium carbonate, *green* sodium manganate is produced. If this be added to water, it communicates a purplish-red color.

Officinal Preparations of Manganese.

Officinal Name.	Preparation.
Mangani Oxidum Nigrum	Binoxide of manganese, containing at least 66 per cent. of pure oxide.
Mangani Sulphas	Made by treating manganese dioxide with sulphuric acid.
Potassii Permanganas	By heating manganese dioxide, potassium hydrate, and potassium chlorate together.

Unofficinal Preparations of Manganese.

Mangani Arsenias, $MnHAsO_4$, = 193.9. Arseniate of Manganese.	By saturating a solution of arsenic acid with freshly-precipitated manganese carbonate.
Mangani Benzoas. Benzoate of Manganese.	By adding to a solution of benzoic acid, manganese carbonate as long as combination is effected.
Mangani Carbonas, $MnCO_3$, = 114. Carbonate of Manganese.	By adding to a solution of manganese sulphate a solution of potassium carbonate, and collecting and drying the precipitate.
Mangani Chloridum, $MnCl_2$, = 124.8. Chloride of Manganese.	By treating manganese dioxide with hydrochloric acid, purifying from iron salts, evaporating and crystallizing.
Mangani Citras. Citrate of Manganese.	By digesting manganese carbonate with citric acid, and collecting the precipitate.
Mangani Oxalas, $2MnC_2O_4.5H_2O$, = 374. Oxalate of Manganese.	By adding to a solution of manganese sulphate a solution of oxalic acid, and collecting the precipitate.
Mangani Tartras. Tartrate of Manganese.	By adding a solution of neutral potassium tartrate to a solution of manganous chloride, and, after the acid tartrate of potassium has deposited, collecting the colorless crystals.

MANGANI OXIDUM NIGRUM. *U.S.* Black Oxide of Manganese.

[DIOXIDE OF MANGANESE.]

Native, crude Binoxide of Manganese, containing at least 66 per cent. of the pure Oxide [MnO_2; 86].

Black oxide of manganese is frequently found in commerce of poor and variable quality: some pyrolusite from Nova Scotia was examined by the author a few years ago, however, which assayed 96 per cent. of pure oxide. It is the safest rule to buy it only upon assay, and, when a good sample can be found, to secure a large quantity of it.

Mangani Oxidum Nigrum. *U.S.*	QUANTITATIVE TEST.
A heavy, grayish-black, more or less gritty powder, permanent in the air, odorless and tasteless, and insoluble in water or alcohol. At a red heat the Oxide gives off oxygen gas; and, if heated with hydrochloric acid, it causes the evolution of chlorine gas. On intimately mixing 1 part of the Oxide with 1 part of hydrate of potassium and 1 part of chlorate of potassium, introducing the mass into a crucible, moistening with water, drying and igniting, a dark, fused mass is obtained, which yields a green solution with water, changing to purplish red on being boiled or on the addition of diluted sulphuric acid.	If 5 Gm. of the finely powdered Oxide be digested with 15 Gm. of water and 20 Gm. of hydrochloric acid, then 21 Gm. of ferrous sulphate be added, and the mixture heated to boiling, the cooled filtrate should not acquire a blue color on the addition of freshly prepared test-solution of ferricyanide of potassium (presence of at least 66 per cent. of pure Dioxide of Manganese).

Uses.—Manganese dioxide is occasionally used internally, in doses of three to twenty grains. Its principal use is to form the salts of manganese.

MANGANI SULPHAS. *U.S.* Sulphate of Manganese.

$MnSO_4.4H_2O$; 222.

Preparation.—This salt is best made by Prof. Diehl's process, by heating manganese dioxide and charcoal together to redness, treating the residue with sulphuric acid, and again heating to redness; the residue is dissolved in water, the solution filtered and crystallized. (See U.S. Dispensatory, 15th ed., p. 920.)

Mangani Sulphas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, or pale rose-colored, transparent, right-rhombic prisms, crystallized at a temperature between 20° and 30° C. (68°–86° F.), slightly efflorescent in dry air.	Odorless; slightly bitter and astringent taste; faintly acid reaction.	Cold. 0.7 part. Boiling. 0.8 part.	Insoluble.

Tests for Identity.	Impurities.	Tests for Impurities.
Sulphate of Manganese affords with test-solution of ferrocyanide of potassium a reddish-white precipitate, and a brown one with test-solution of ferricyanide of potassium. Test-solution of chloride of barium produces a white precipitate insoluble in hydrochloric acid.	Zinc.	The aqueous solution of the salt yields, with sulphide of ammonium, a flesh-colored precipitate completely soluble in moderately diluted acetic acid.
	Iron.	The aqueous solution of the salt should not be affected by solution of tannic acid.
	Copper.	When slightly acidulated with hydrochloric acid, it should remain unaffected by hydrosulphuric acid.
	Alkalies or Magnesia.	If all the Manganese be precipitated from the aqueous solution by sulphide of ammonium, and the filtrate be evaporated, not more than a trace of fixed residue should remain on gentle ignition.

Uses.—Manganese sulphate is used as a tonic, in doses of five to twenty grains.

POTASSII PERMANGANAS. *U.S.* **Permanganate of Potassium.**

This is the most important officinal compound of manganese. It is considered under the potassium compounds (page 463).

Iron. Fe; 55.9.

Iron, the most useful and abundant of the metals, is widely diffused in nature: it is found not only in the mineral kingdom, but in animal and vegetable products as well.

Iron is a hard, malleable, ductile, and tenacious metal, of a grayish-white color and fibrous texture, a slightly styptic taste, and a sensible odor when rubbed. Its sp. gr. is 7.8. It is combustible, and, when heated to whiteness, burns in atmospheric air, and with brilliant scintillations in oxygen. At a red heat its surface is converted into black oxide, and at common temperatures, by the combined agency of air and moisture, it becomes covered with a reddish matter, called *rust*, which is hydrated ferric oxide. It combines with all the non-metallic elements except hydrogen and nitrogen, and with most of the metals. It forms three compounds with oxygen,—ferrous and ferric oxide, which, by their union, form the native magnetic oxide, and a teroxide possessing acid properties, called ferric acid.

Tests for Iron Salts.

1. Potassium *ferrocyanide* produces a nearly white precipitate with a ferrous salt, which rapidly turns blue on exposure to the air; with a ferric salt it strikes a deep blue color (Prussian blue) at once.

2. Potassium *ferricyanide* produces a deep blue color (Turnbull's blue) at once with a ferrous salt, and a greenish or olive color with a ferric salt.

3. Tannin does not change the color of a solution of a ferrous salt, provided it has not been oxidized; with a ferric salt a dark greenish-black precipitate (ink) is produced.

4. Ammonium sulphide produces a black precipitate (sulphide) with either a ferrous or a ferric salt.

5. Water of ammonia precipitates from ferrous salts, ferrous hydrate, a white precipitate turning green, then black, and finally a brown color; the same reagent precipitates brown ferric hydrate from ferric salts.

Officinal Preparations of Iron.

Officinal Name.	Preparation.
Ferrum	Metallic iron in the form of fine, bright, and non-elastic wire.
Ferrum Reductum	Made by passing hydrogen over subcarbonate of iron.
Ferri Carbonas Saccharatus	Double decomposition between ferrous sulphate and sodium bicarbonate; the precipitate is preserved with sugar.
Massa Ferri Carbonatis	Double decomposition between ferrous sulphate and sodium carbonate; the precipitate is preserved with honey.
Mistura Ferri Composita	6 p. sulphate of iron; 18 p. myrrh; 18 p. sugar; 8 p. carbonate of potassium; 50 p. spirit of lavender; 900 p. rose water.
Pilulæ Ferri Compositæ	Sulphate of iron, ⅓ gr., carbonate of sodium, ¼ gr., myrrh 1½ gr., syrup q. s., in each pill.
Ferri Chloridum	By acting on iron with hydrochloric acid and crystallizing the solution.
Liquor Ferri Chloridi	By oxidizing solution of ferrous chloride with nitric acid.
Tinctura Ferri Chloridi	35 parts of solution of ferric chloride to 65 parts of alcohol.
Ferri Citras	By evaporating and scaling solution of ferric citrate.
Ferri et Ammonii Citras	By adding water of ammonia to solution of ferric citrate, evaporating, and scaling.
Liquor Ferri Citratis	By dissolving ferric hydrate in citric acid.
Vinum Ferri Citratis	4 p. citrate of iron and ammonia; 12 p. tincture of sweet orange peel; 12 p. syrup; 72 p. stronger white wine.
Ferri et Quininæ Citras	By dissolving quinine (alkaloid) in solution of ferric citrate, evaporating, and scaling.
Liquor Ferri et Quininæ Citratis	By adding to a solution of citrate of iron and ammonium citric acid and quinine.
Vinum Ferri Amarum	8 p. solution of citrate of iron and quinine; 12 p. tincture of sweet orange peel; 36 p. syrup; 44 p. stronger white wine.
Ferri et Strychninæ Citras	By adding to a solution of citrate of iron and ammonium citric acid and strychnine, and scaling.
Syrupus Ferri, Quininæ et Strychninæ Phosphatum	By dissolving in an acid solution of ferric phosphate quinine, strychnine, and sugar.
Ferri et Ammonii Sulphas	By dissolving sulphate of ammonium in solution of tersulphate of iron, evaporating, and crystallizing.
Ferri et Ammonii Tartras	By dissolving ferric hydrate in solution of acid ammonium tartrate, and scaling.
Ferri et Potassii Tartras	By adding to ferric hydrate acid potassium tartrate and a trace of water of ammonia, and scaling.
Ferri Hypophosphis	Double decomposition between calcium hypophosphite and ferrous sulphate.

Officinal Preparations of Iron.—(*Continued.*)

Officinal Name.	Preparation.
Ferri Iodidum Saccharatum	By adding solution of ferrous iodide to sugar of milk.
Syrupus Ferri Iodidi	By adding solution of ferrous iodide to sugar.
Syrupus Ferri Bromidi	By adding solution of ferrous bromide to sugar.
Pilulæ Ferri Iodidi	0.6 gr. reduced iron, 0.8 gr. iodine, 0.5 gr. glycyrrhiza, 0.5 gr. sugar, 0.12 gr. ext. glycyrrhiza, 0.12 gr. acacia, water q. s., in each pill.
Ferri Lactas	By acting on iron with lactic acid and crystallizing the solution.
Ferri Oxalas	By mixing solutions of ferrous sulphate and oxalic acid and collecting the precipitate.
Ferri Oxidum Hydratum	By adding water of ammonia to solution of tersulphate of iron, and collecting and washing the precipitate.
Ferri Oxidum Hydratum cum Magnesia	By mixing solution of tersulphate of iron with magnesia mixture.
Trochisci Ferri	Each lozenge contains 5 gr. of dried ferric hydrate.
Emplastrum Ferri	10 p. dried hydrated oxide of iron; 10 p. Canada turpentine; 10 p. Burgundy pitch; 70 p. lead plaster.
Ferri Phosphas	By mixing solutions of citrate of iron and phosphate of sodium, evaporating and scaling.
Ferri Pyrophosphas	By mixing solutions of citrate of iron and pyrophosphate of sodium, evaporating and scaling.
Ferri Sulphas	By treating iron with diluted sulphuric acid, evaporating and crystallizing.
Ferri Sulphas Exsiccatus	By exsiccating ferrous sulphate at a temperature not above 149° C. (300° F.).
Pilulæ Aloes et Ferri	1 gr. purified aloes, 1 gr. sulphate of iron, 1 gr. aromatic powder, confection of rose q. s., in each pill.
Ferri Sulphas Præcipitatus	By precipitating an aqueous solution of ferrous sulphate with alcohol.
Ferri Valerianas	By double decomposition between ferric sulphate and sodium valerianate.
Liquor Ferri Acetatis	By dissolving ferric hydrate in glacial acetic acid.
Tinctura Ferri Acetatis	By mixing 50 p. solution of acetate of iron; 30 p. alcohol; 20 p. acetic ether.
Mistura Ferri et Ammonii Acetatis	2 p. tincture chloride of iron; 3 p. diluted acetic acid; 20 p. solution acetate of ammonium; 10 p. elixir of orange; 15 p. syrup; 50 p. water.
Liquor Ferri Nitratis	By dissolving ferric hydrate in diluted nitric acid.
Liquor Ferri Subsulphatis	By heating ferrous sulphate in a mixture of sulphuric and nitric acids.
Liquor Ferri Tersulphatis	By heating ferrous sulphate in a mixture of nitric acid with excess of sulphuric acid.

Unofficinal Salts of Iron.

Ferri Acetas, $Fe_2(C_2H_3O_2)_6$, = 465.8. Acetate of Iron.	By dissolving ferric hydrate in acetic acid, evaporating, then crystallizing.
Ferri Arsenias, $3Fe(FeO)AsO_4 . 16H_2O$, = 1088.1. Arseniate of Iron.	By dissolving 1 oz. sodium arseniate and ¾ oz. sodium acetate in 8 oz. water, then dissolving 2 oz. ferrous sulphate in 10 fl. oz. water, mixing both solutions, collecting the precipitate, washing and drying.
Ferri Benzoas, $Fe_36C_7H_5O_2 . 6H_2O$, = 945.8. Benzoate of Iron.	By adding to a solution of normal ferric sulphate a concentrated solution of sodium benzoate, collecting the precipitate, washing and drying.
Ferri Bromidum, $FeBr_3$, = 215.9. Bromide of Iron.	By adding 2 p. bromine to 1 p. iron filings and 10 p. water, digesting until the liquid assumes a greenish color, then filtering and evaporating to dryness.
Ferri et Sodii Pyrophosphas. Pyrophosphate of Iron and Sodium.	By adding to a solution of 50 p. sodium pyrophosphate in 100 p. water sufficient ferric chloride in aqueous solution so that a permanent precipitate is not produced, then adding 250 p. alcohol and collecting the precipitate.

Unofficinal Salts of Iron.—(*Continued.*)

Ferri Ferrocyanidum, $Fe_4(FeCN_6)_3$, = 859.3. Ferrocyanide of Iron.	By dissolving 4½ oz. potassium ferrocyanide in 1 pint water, adding this solution to 8 fl. oz. solution of normal ferric sulphate diluted previously with 8 fl. oz. water, stirring continually and collecting the precipitate, washing and drying.
Ferri Nitras, $Fe_2(NO_3)_6$, = 483.8. Nitrate of Iron.	By concentrating a solution of ferric nitrate, filtering and allowing to crystallize.
Ferri Oxidum Magneticum, Fe_3O_4, = 231.7. Magnetic Oxide of Iron.	By dissolving 2 oz. ferrous sulphate in 2 pints water and adding 5½ fl. oz. solution of normal ferric sulphate, then mixing this with 4 pints solution of soda, stirring well, boiling, letting it stand for 2 hours, occasionally stirring, collecting the precipitate, washing, and drying carefully.
Ferri Oxidum Rubrum. Red Oxide of Iron.	By igniting ferrous sulphate in contact with air.
Ferri Phosphas Albus, $Fe_2 2PO_4$. $4H_2O$, = 373.8. White Phosphate of Iron.	By mixing 4 fl. oz. solution of normal ferric sulphate with a solution of 1 oz. sodium acetate, then adding solution of sodium phosphate, and collecting the precipitate, washing and drying.
Ferri Salicylas. Salicylate of Iron.	By mixing a solution containing 24 grains of ferrous sulphate and 20 grains of sodium acetate in half a fluidounce of water with a solution made by dissolving 30 grains of sodium salicylate in half a fluidounce of water. The resulting liquid is administered in doses of a teaspoonful, each containing about 4 grains of salicylate of iron.
Ferri Subcarbonas. Subcarbonate of Iron.	By mixing solutions of 8 oz. ferrous sulphate and 9 oz. sodium carbonate, collecting the precipitate, washing, and drying without heat.
Ferri Sulphidum, FeS, = 87.9. Sulphide of Iron.	By mixing 3 p. iron filings with 2 p. sublimed sulphur, then adding in small portions the above mixture into a crucible heated to redness, and keeping covered after each addition.

FERRUM. *U.S.* Iron.

Fe; 55.9.

Metallic Iron, in the form of fine, bright, non-elastic wire.

Iron, when employed in pharmaceutical operations, should be of the purest kind: hence the Pharmacopœias generally direct it, when wanted in small masses, to be in the form of *iron wire*, which is necessarily made from the purest, because the softest and most ductile, iron, and is readily cut into pieces. Such wire is very flexible and without elasticity.

The wire clippings and the ends of card-teeth obtained from the manufacturers of cotton-cards are frequently used in Philadelphia for making iron preparations. They are very convenient; and it may be incidentally mentioned that they are sometimes used as a substitute for sand, in sand-baths.

FERRUM REDUCTUM. *U.S.* Reduced Iron.

Fe; 55.9.

Preparation.—Reduced iron may be made by a process originally proposed by Prof. Procter, and afterwards made officinal in 1870:

Take of Subcarbonate of Iron 30 oz. troy. Wash the Subcarbonate thoroughly with water until no traces of sulphate of sodium are indicated by the appropriate tests, and calcine it in a shallow vessel until free from moisture. Then spread it upon a tray, made by bending an oblong piece of sheet-iron in the form of an incomplete cylinder, and introduce this into a wrought-iron reduction-tube, of about four inches

in diameter. Place the reduction-tube in a charcoal furnace, and, by means of a self-regulating generator of hydrogen, pass through it a stream of that gas, previously purified by bubbling successively through solution of subacetate of lead, diluted with three times its volume of water, and through milk of lime, severally contained in four-pint bottles about one-third filled. Connect with the further extremity of the reduction-tube a lead tube bent so as to dip into water. Make all the junctions air-tight by appropriate lutes; and, when the hydrogen has passed long enough to fill the whole of the apparatus to the exclusion of atmospheric air, light the fire, and bring that part of the reduction-tube, occupied by the Subcarbonate, to a dull-red heat, which must be kept up so long as the bubbles of hydrogen, breaking from the water covering the orifice of the lead tube, are accompanied by visible aqueous vapor. When the reduction is completed, remove the fire, and allow the whole to cool to the ordinary temperature, keeping up, during the refrigeration, a moderate current of hydrogen through the apparatus. Withdraw the product from the reduction-tube, and, should any portion of it be black instead of iron-gray, separate such portion for use in a subsequent operation. Lastly, having powdered the Reduced Iron, keep it in a well-stopped bottle. When thirty troyounces of Subcarbonate of Iron are operated on, the process occupies from five to eight hours.

The subcarbonate directed in the above formula is, more correctly, a ferric oxyhydrate, and the hydrogen combines with the oxygen to form water, metallic iron, in fine powder, being left.

$$\underset{\text{Ferric Oxide.}}{Fe_2O_3} + \underset{\text{Hydrogen.}}{6H} = \underset{\text{Iron.}}{2Fe} + \underset{\text{Water.}}{3H_2O}.$$

Ferrum Reductum. *U.S.*	Quantitative Test.
A very fine, grayish-black, lustreless powder, permanent in dry air, without odor or taste, and insoluble in water or alcohol. When ignited in contact with air, it is converted into ferric oxide. When treated with diluted sulphuric acid, it causes the evolution of nearly odorless hydrogen gas, and, on being warmed, it is dissolved without leaving a residue.	If 1 Gm. of Reduced Iron be digested with 3.5 Gm. of iodine, 2.5 Gm. of iodide of potassium, and 50 C.c. of distilled water for two hours, the resulting filtrate should have a green color, and should not be rendered blue by gelatinized starch (presence of at least 80 per cent. of metallic iron).

Uses.—Powder of iron, or reduced iron, is one of the best of the chalybeate tonics. It is generally given in pill form, in doses of three to six grains. An elegant form of administering it is combined with chocolate in the form of lozenges.

FERRI CARBONAS SACCHARATUS. *U.S.* Saccharated Carbonate of Iron.

[Saccharated Ferrous Carbonate.]

Sulphate of Iron, 10 parts, or . . . . . 5 oz. av.
Bicarbonate of Sodium, 7 parts, or . . . . . 3½ oz. av.
Sugar, in fine powder, 16 parts, or . . . . . 8 oz. av.
Distilled Water, a sufficient quantity.

Dissolve the Sulphate of Iron in *forty parts* [or 20 fl. oz.] of hot Distilled Water, and the Bicarbonate of Sodium in *one hundred parts* [or 3 pints] of warm Distilled Water, and filter the solutions separately, and allow them to cool. Add the solution of Sulphate of Iron gradually to the solution of Bicarbonate of Sodium contained in a capacious flask, and mix thoroughly by shaking. Fill up the flask with boiling Distilled Water, and set the mixture aside for two hours. Draw off the supernatant liquid from the precipitate by means of a syphon, and then fill the flask again with hot Distilled Water and shake it. Pour off the clear liquid and repeat the operation until the decanted liquid gives but a slight turbidity with test-solution of chloride of barium. Transfer the drained precipitate to a porcelain capsule containing the Sugar, and mix intimately; evaporate the mixture to dryness, by means of a water-bath, and reduce the product to powder. Keep the powder in small, well-stopped vials.

In this preparation ferrous carbonate is formed, sodium sulphate remaining in solution. Sodium bicarbonate is preferred because the evolution of carbonic acid during the decomposition measurably prevents oxidation: it would have been an improvement to use syrup in the solutions to protect them still further.

The object of boiling the water that is used in washing is to expel the air, so that the ferrous carbonate may escape its oxidizing action; the evaporation of the mixture should be conducted as rapidly as possible, for the same reason.

$$\underset{\text{Ferrous Sulphate.}}{FeSO_4} + \underset{\text{Sodium Bicarbonate.}}{2NaHCO_3} = \underset{\text{Sodium Sulphate.}}{Na_2SO_4} + \underset{\text{Ferrous Carbonate.}}{FeCO_3} + \underset{\text{Water.}}{H_2O} + \underset{\text{Carbon Dioxide.}}{CO_2}$$

Ferri Carbonas Saccharatus. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Other Solvents.
A greenish-gray powder, gradually oxidized by contact with air, but completely soluble, with copious evolution of carbonic acid gas, in diluted hydrochloric acid, forming a clear, yellow liquid.	Odorless; at first a sweetish, afterwards a slightly ferruginous taste; neutral reaction.	Partially soluble.	Completely soluble, with copious evolution of carbonic acid gas, in diluted hydrochloric acid, forming a clear, yellow liquid.

Quantitative Test.	Impurities.	Test for Impurities.
If 8 Gm. of the Saccharated Carbonate of Iron be dissolved in water with an excess of hydrochloric acid, and the solution mixed with 33 C.c. of the volumetric solution of bichromate of potassium, the mixture should still afford a blue color or precipitate with test-solution of ferricyanide of potassium (presence of at least 15 per cent. of ferrous carbonate).	Sulphate.	A solution of the salt in hydrochloric acid affords a blue precipitate with test-solution either of ferrocyanide or of ferricyanide of potassium, but should not be rendered more than slightly turbid by test-solution of chloride of barium.

Uses.—Saccharated ferrous carbonate is used as a tonic, in doses of five to thirty grains.

MASSA FERRI CARBONATIS. *U. S.* **Mass of Carbonate of Iron.**
[PILULA FERRI CARBONATIS, Pharm. 1870.]

	By measure.
Sulphate of Iron, 100 parts, or	8 oz. av.
Carbonate of Sodium, 110 parts, or	8 oz. av. 350 gr.
Clarified Honey, 88 parts, or	3 oz. av.
Sugar, in coarse powder, 25 parts, or	2 oz. av.
Syrup,	
Distilled Water, each, a sufficient quantity,	
To make 100 parts, or	8 oz. av.

Dissolve the Sulphate of Iron and the Carbonate of Sodium separately, each in *two hundred parts* [or 1 pint] of boiling Distilled Water, and, having added *twenty-five parts* [or 1½ fl. oz.] of Syrup to the solution of the iron salt, filter both solutions. Mix them, when cold, in a bottle just large enough to hold them, or add enough Distilled Water to fill it; close the bottle accurately with a stopper, and set it aside so that the carbonate of iron may subside. Pour off the supernatant liquid, and, having mixed Syrup and Distilled Water in the proportion of *one part* [or 6 fl. dr.] of Syrup to *sixteen parts* [or 1 pint] of Water, wash the precipitate with the mixture until the washings no longer have a saline taste. Drain the precipitate on a flannel cloth, and express as much of the Water as possible. Lastly, mix the precipitate immediately with the Honey and Sugar, and, by means of a water-bath, evaporate the mixture, constantly stirring, until it is reduced to *one hundred parts* [or 8 oz. av.].

This preparation consists of ferrous carbonate preserved from oxidation by contact with syrup and honey. The reaction is as follows:

$$\underset{\text{Ferrous Sulphate.}}{FeSO_4} + \underset{\text{Sodium Carbonate.}}{Na_2CO_3} = \underset{\text{Ferrous Carbonate.}}{FeCO_3} + \underset{\text{Sodium Sulphate.}}{Na_2SO_4}.$$

Uses.—Mass of carbonate of iron is widely known as *Vallet's mass:* it is a valuable chalybeate tonic, and is administered in pill form, in doses of five to fifteen grains.

MISTURA FERRI COMPOSITA. *U.S.* **Compound Iron Mixture.**

This mixture depends for its usefulness upon the ferrous carbonate produced by double decomposition between ferrous sulphate and potassium carbonate. The myrrh, sugar, spirit of lavender, and rose-water are used as adjuvants and diluents (see p. 273).

PILULÆ FERRI COMPOSITÆ. *U.S.* **Compound Pills of Iron.**

Each pill contains 1½ gr. of myrrh, ¾ gr. of ferrous sulphate, and ¾ gr. of sodium carbonate, with sufficient syrup to form a mass. When the pill reaches the fluids in the stomach, ferrous carbonate is produced through the reaction between the ferrous sulphate and sodium carbonate.

FERRI CHLORIDUM. *U.S.* Chloride of Iron.

$Fe_2Cl_6.12H_2O$; 540.2. [FERRIC CHLORIDE.]

	By measure.
Iron, in the form of fine wire and cut into small pieces, 15 parts, or . .	2 oz. av.
Hydrochloric Acid, 86 parts, or	9½ fl. oz.
Nitric Acid,	
Distilled Water, each, a sufficient quantity.	

Put the Iron Wire into a flask capable of holding double the volume of the intended product, pour upon it *fifty-four parts* [or 6 fl. oz.] of Hydrochloric Acid previously diluted with *twenty-five parts* [or 3 fl. oz.] of Water, and let the mixture stand until effervescence ceases; then heat it to the boiling point, filter through paper, and, having rinsed the flask and Iron Wire with a little boiling Distilled Water, pass the rinsings through the filter. To the filtered liquid add *twenty-seven parts* [or 3 fl. oz.] of Hydrochloric Acid, and pour the mixture slowly and gradually, in a stream, into *eight parts* [or 6 fl. dr.] of Nitric Acid, contained in a capacious porcelain vessel. After effervescence ceases, apply heat, by means of a sand-bath, until the liquid is free from nitrous odor; then test a small portion with freshly-prepared test-solution of ferricyanide of potassium. Should this reagent produce a blue color, add a little more Nitric Acid and evaporate off the excess. Then add the remaining *five parts* [or 4 fl. dr.] of Hydrochloric Acid, and enough Distilled Water to make the whole weigh *sixty parts* [or 8 oz. av.], and set this aside, covered with glass, until it forms a solid, crystalline mass. Lastly, break it into pieces, and keep the fragments in a glass-stoppered bottle, protected from light.

When hydrochloric acid acts upon iron, water is decomposed, hydrogen is evolved, and ferrous chloride is produced.

$$\underset{\text{Iron.}}{Fe_2} + \underset{\substack{\text{Hydrochloric}\\\text{Acid.}}}{4HCl} = \underset{\substack{\text{Ferrous}\\\text{Chloride.}}}{(FeCl_2)_2} + \underset{\text{Hydrogen.}}{4H.}$$

Ferrous chloride is converted into ferric chloride by the addition of nitric and hydrochloric acids; thus,—

$$\underset{\substack{\text{Ferrous}\\\text{Chloride.}}}{6FeCl_2} + \underset{\substack{\text{Hydrochloric}\\\text{Acid.}}}{6HCl} + \underset{\substack{\text{Nitric}\\\text{Acid.}}}{2HNO_3} = \underset{\substack{\text{Ferric}\\\text{Chloride.}}}{3Fe_2Cl_6} + \underset{\substack{\text{Nitrogen}\\\text{Dioxide.}}}{N_2O_2} + \underset{\text{Water.}}{4H_2O.}$$

Ferri Chloridum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Orange-yellow, crystalline pieces, very deliquescent. On ignition, the salt suffers partial decomposition.	Odorless, or having a faint odor of hydrochloric acid; strongly styptic taste; acid reaction.	Freely and wholly soluble.	Freely and wholly soluble.	Freely and wholly soluble in ether.

Tests for Identity.	Impurities.	Tests for Impurities.
The dilute aqueous solution yields a brown-red precipitate with water of ammonia, a blue one with test-solution of ferrocyanide of potassium, and a white one, insoluble in nitric acid, with test-solution of nitrate of silver.	Zinc and Copper.	If the iron be completely precipitated from a solution of the salt by an excess of water of ammonia, the filtrate should not yield either a white or a dark-colored precipitate with hydrosulphuric acid.
	Fixed Alkalies.	A solution of the salt, after the iron has been completely precipitated by an excess of ammonia, should not leave a fixed residue on evaporation and gentle ignition.
	Nitric Acid.	On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a moderately dilute solution of the salt, the crystal should not become colored brown, nor should there be a brownish-black zone developed around it.
	Ferrous Salt.	A few drops of a solution of the salt, added to freshly prepared test-solution of ferricyanide of potassium, should impart to the latter a pure greenish-brown color without a trace of blue.
	Oxychloride.	A 1 per cent. solution of the salt in distilled water, when boiled in a test-tube, should remain clear.

Uses.—Chloride of iron is used externally as a styptic, and internally as a chalybeate tonic, in doses of three to five grains.

LIQUOR FERRI CHLORIDI. *U.S.* Solution of Chloride of Iron.

[Solution of Ferric Chloride.]

An aqueous solution (with some free Hydrochloric Acid) of Ferric Chloride [Fe_2Cl_6; 324.2], containing 37.8 per cent. of the anhydrous salt.

	By measure.
Iron, in the form of fine wire and cut into small pieces, 15 parts, or . .	3½ oz. av.
Hydrochloric Acid, 86 parts, or	16¾ fl. oz.
Nitric Acid,	
Distilled Water, each, a sufficient quantity,	
To make 100 parts, or	1 pint.

Put the Iron Wire into a flask capable of holding double the volume of the intended product. Pour upon it *fifty-four parts* [or 10½ fl. oz.] of Hydrochloric Acid previously diluted with *twenty-five parts* [or 5½ fl. oz.] of Distilled Water, and let the mixture stand until effervescence ceases; then heat it to the boiling point, filter through paper, and, having rinsed the flask and Iron Wire with a little boiling Distilled Water, pass the washings through the filter. To the filtered liquid add *twenty-seven parts* [or 5¼ fl. oz.] of Hydrochloric Acid, and pour the mixture, slowly and gradually, in a stream, into *eight parts* [or 1 fl. oz. 3 fl. dr.] of Nitric Acid contained in a capacious porcelain vessel. After effervescence ceases, apply heat, by means of a sand-bath, until the liquid is free from nitrous odor. Then test a small portion with freshly prepared test-solution of ferricyanide of potassium. Should this reagent produce a blue color, add a little more Nitric Acid and evaporate off the excess. Finally, add the remaining *five parts* [or 1 fl. oz.] of Hydrochloric Acid, and enough Distilled Water to make the solution weigh *one hundred parts* [or measure 1 pint].

The reaction which takes place here is exactly the same as that in ferric chloride, which has been described on page 558; the processes being

identical with one exception, that the solution is crystallized to make the salt. If this solution, when finished, has a blackish color, it is due to incomplete oxidation, and the remedy is to heat it to boiling in a capacious dish, adding a few drops of nitric acid until the color changes to a clear ruby-red and effervescence ceases. If a brown precipitate is deposited upon dilution or standing, deficiency of hydrochloric acid is indicated, and the solution must be heated, and a few drops of the acid added until the precipitate is dissolved.

Liquor Ferri Chloridi. *U.S.*	Odor, Taste, and Reaction.
A reddish-brown liquid.	Faint odor of hydrochloric acid · acid, strongly styptic taste; acid reaction.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The diluted Solution affords a brown-red precipitate with water of ammonia, a blue one with test-solution of ferrocyanide of potassium, and a white one, insoluble in nitric acid, with test-solution of nitrate of silver.	Zinc, Copper.	If the iron be completely precipitated from a portion of the Solution by excess of water of ammonia, the filtrate should not yield either a white or a dark-colored precipitate with hydrosulphuric acid.
	Fixed Alkalies.	The Solution, after the iron has been completely precipitated from it by an excess of ammonia, should leave no fixed residue on evaporation and gentle ignition.
	Nitric Acid.	On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a moderately dilute portion of the Solution, the crystal should not be colored brown, nor should there be a brownish-black zone developed around it.
10 Gm. of the Solution, when completely precipitated by excess of water of ammonia, yield a precipitate, which, when washed, dried, and ignited, should weigh 1.86 Gm.	Ferrous Salt.	A few drops added to freshly prepared test-solution of ferricyanide of potassium should impart to it a pure greenish-brown color without a trace of blue.
	Oxychloride.	On diluting 3 parts of the Solution with distilled Water to 100 parts, and boiling in a test-tube, the liquid should remain clear.

Uses.—This solution is occasionally used as a hæmostatic: its principal use, however, is to form, by dilution with alcohol, the well-known tincture of chloride of iron.

TINCTURA FERRI CHLORIDI. *U.S.* Tincture of Chloride of Iron.

This tincture is made by diluting thirty-five parts of solution of chloride of iron with sixty-five parts of alcohol, the mixture to stand in a closely-covered vessel at least three months: it is then to be transferred to glass-stoppered bottles (see page 311). The object of allowing the mixture to stand three months before it is to be used is to permit the formation of ethyl chloride and other similar ethereal compounds, the result of the action of the free acid on the alcohol. These ethers are supposed to give to the tincture diuretic properties. If a brownish-red precipitate of ferric oxychloride takes place upon diluting the solution of chloride of iron, it shows that the solution has not been made properly and is deficient in free hydrochloric acid (see above).

Uses.—Tincture of chloride of iron is undoubtedly the most important liquid iron preparation that is used: it is an efficient chalybeate, tonic, and styptic. The dose is from ten to thirty minims, diluted with water: it should be sucked through a glass tube, to prevent injury to the teeth.

FERRI CITRAS. *U.S.* Citrate of Iron.

$Fe_3(C_6H_5O_7)_2.6H_2O$; 597.8. [FERRIC CITRATE.]

Solution of Citrate of Iron, *a convenient quantity.* Evaporate the Solution, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.

Ferri Citras. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Transparent, garnet-red scales, permanent in the air.	Odorless; very faint ferruginous taste; acid reaction.	Cold. Slowly but completely soluble. Boiling. Readily soluble.	Insoluble.

Tests for Identity.	Impurities.	Test for Impurities.
The aqueous solution of the salt is not precipitated, but is rendered darker, by water of ammonia. If heated with solution of potassa, it affords a brown-red precipitate, without evolving any vapor of ammonia. On adding test-solution of ferrocyanide of potassium to an aqueous solution of the salt, a bluish-green color or precipitate is produced, which is increased and rendered dark blue by the subsequent addition of hydrochloric acid (difference from citrate of iron and ammonium). If a solution of the salt be deprived of its iron by boiling with an excess of solution of potassa, the concentrated and cooled filtrate precipitated with test-solution of chloride of calcium, and the new filtrate heated to boiling, a white, granular precipitate will be produced.	Fixed Alkalies.	When strongly heated, the salt emits fumes having the odor of burnt sugar, and finally leaves a residue amounting to 26 per cent. of the original weight, which should not have an alkaline reaction.

Uses.—This salt is *very slowly* soluble in water, and hence is not largely used in making solutions. It is very useful in making pills, where its slow solubility is an advantage in preventing the flattening and cohering which usually takes place when the more soluble form is used. The dose is five to twenty grains.

FERRI ET AMMONII CITRAS. *U.S.* Citrate of Iron and Ammonium.

[AMMONIO-FERRIC CITRATE.]

	By measure.
Solution of Citrate of Iron, 3 parts, or	1 pint.
Water of Ammonia, 1 part, or	7 fl. oz.

Mix the Solution of Citrate of Iron with the Water of Ammonia, evaporate the mixture, at a temperature not exceeding 60° C. (140° F.),

to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stopped bottles in a dark place.

Prof. J. U. Lloyd modifies this process with advantage by using, instead of water of ammonia, a definite quantity of ammonium citrate in solution (see U. S. Dispensatory, 15th ed., p. 663).

Ferri et Ammonii Citras. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Transparent, garnet-red scales, deliquescent on exposure to damp air.	Odorless; saline, mildly ferruginous taste; neutral reaction.	Readily and wholly soluble.	Insoluble.

Tests for Identity.	Impurities.	Test for Impurities.
The aqueous solution of the salt is not precipitated, but is rendered darker, by water of ammonia. If heated with solution of potassa, it affords a brown-red precipitate, and vapor of ammonia is evolved. On adding test-solution of ferrocyanide of potassium to an aqueous solution of the salt, no blue color or precipitate is produced unless the solution is acidulated with hydrochloric acid (difference from citrate of iron). If a solution of the salt be deprived of its iron by boiling with an excess of solution of potassa, the concentrated and cooled filtrate precipitated with test-solution of chloride of calcium, and the new filtrate heated to boiling, a white, granular precipitate will be produced.	Fixed Alkalies.	When strongly heated, the salt emits fumes having the odor of burnt sugar, and finally leaves a residue, amounting to about 25 per cent. of the original weight, which should not have an alkaline reaction.

Uses.—Ammonio-ferric citrate is a useful modification of ferric citrate, the object of adding the water of ammonia being to make the salt more soluble. The dose is five to twenty grains.

LIQUOR FERRI CITRATIS. *U.S.* Solution of Citrate of Iron.

[Solution of Ferric Citrate.]

An aqueous solution of Ferric Citrate [$Fe_2(C_6H_5O_7)_2$; 489.8], containing about 35.5 per cent. of the anhydrous salt.

	By measure.
Solution of Tersulphate of Iron, 105 parts, or	10½ oz. av.
Citric Acid, 30 parts, or	3 oz. av.
Water of Ammonia, 84 parts, or	8½ fl. oz.
Water, a sufficient quantity,	
To make 100 parts, or	10 oz. av.

To the Water of Ammonia previously diluted with *two hundred parts* [or 20 fl. oz.] of cold Water, add, constantly stirring, the Solution of Tersulphate of Iron previously diluted with *one thousand parts* [or 6 pints] of cold Water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel and mix it intimately with *twelve hundred parts* [or 7½ pints] of cold Water. Again drain it on a strainer, and repeat the operation until the washings cause but a very slight cloudiness with test-solution of chloride of barium; then

allow the excess of Water to drain off. Transfer the moist precipitate to a porcelain dish, add the Citric Acid, and heat the mixture, on a water-bath, to 60° C. (140° F.), stirring constantly, until the precipitate is dissolved. Lastly, filter the liquid and evaporate it, at the above-mentioned temperature, until it weighs *one hundred parts* [or 10 oz. av.].

In this preparation ferric hydrate is precipitated, ammonium sulphate being washed out, and the former is then dissolved in citric acid and the solution brought to a definite strength.

$$\underset{\text{Ferric Sulphate.}}{Fe_2 3SO_4} + \underset{\text{Ammonium Hydrate.}}{6NH_4HO} = \underset{\text{Ferric Hydrate.}}{Fe_2(HO)_6} + \underset{\text{Ammonium Sulphate.}}{3(NH_4)_2SO_4}.$$

Liquor Ferri Citratis. *U.S.*	Tests for Identity.
A dark brown liquid, odorless, having a slightly ferruginous taste, and an acid reaction. Sp. gr. 1.260. When allowed to evaporate spontaneously, or at a moderate heat, and spread on plates of glass, it forms transparent, garnet-red scales, which are easily detached from the glass. 100 parts of the Solution, thus treated, yield 43 to 44 parts of scales, which, when completely incinerated, leave about 11 parts of residue.	The Solution is not precipitated, but only rendered darker, by water of ammonia. If heated with solution of potassa, it affords a brown-red precipitate, without evolving any vapor of ammonia. If a portion of the Solution be deprived of its iron by boiling with an excess of solution of potassa, the concentrated and cooled filtrate precipitated by test-solution of chloride of calcium, and the new filtrate heated to boiling, a white, granular precipitate will be produced. On adding test-solution of ferrocyanide of potassium to the diluted Solution, a bluish-green color or precipitate is produced, which is increased and rendered dark blue by the subsequent addition of hydrochloric acid.

Uses.—This solution deserves to be known better and used oftener than it has been in the past. It keeps well, and much labor is saved by the pharmacist if he will use it in all cases where an aqueous solution of ferric citrate is needed. It is just *half* the strength of the scaled salt, and therefore the use of a double quantity of this solution will be found very convenient.

VINUM FERRI CITRATIS. *U.S.* Wine of Citrate of Iron.

This preparation, known more frequently as *Wine of Iron*, is made by dissolving four parts of citrate of iron and ammonium in a mixture of twelve parts each of syrup and tincture of sweet orange-peel, and seventy-two parts of stronger white wine. It is used as an agreeable chalybeate tonic, in doses of a fluidrachm (see page 324).

FERRI ET QUININÆ CITRAS. *U.S.* Citrate of Iron and Quinine.

Citrate of Iron, 88 parts, or	**22 oz. av.**
Quinine, dried at 100° C. (212° F.), until it ceases to lose weight, 12 parts, or	**3 oz. av.**
Distilled Water, a sufficient quantity,	
To make 100 parts, or . . . . . about	**25 oz. av.**

Dissolve the Citrate of Iron in *one hundred and sixty parts* [or 38 fl. oz.] of Distilled Water, by heating on a water-bath, at a temperature not exceeding 60° C. (140° F.). To this solution add the Quinine and

stir constantly until it is dissolved. Lastly, evaporate the solution, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stopped bottles, in a dark place.

This well-known salt is simply a citrate of iron containing quinine in the proper quantity to make a good medicinal preparation. No chemical formula is officinally given to it, for the sufficient reason that it is not regarded as a definite chemical compound. It is frequently found deficient in quinine, and sometimes with a cheaper alkaloid substituted for it.

It is frequently found in the market in light-green scales. This color is due to the use of ammonia or ammonium citrate with the view of making the salt more soluble.

The officinal salt is not intended to be very soluble, the bitter taste being much less perceptible than when ammonia is combined with the citric acid.

Care should be exercised in buying this salt from the manufacturer to specify the U. S. P. salt, as two kinds are sometimes kept for sale.

Ferri et Quininæ Citras. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Transparent, thin scales, varying in color from reddish-brown to yellowish-brown, slowly deliquescent on exposure to air. Slowly but wholly soluble in cold water, more readily so in hot water, and but slightly soluble in alcohol.	Odorless; bitter and mildly ferruginous taste; slightly acid reaction.	Cold. Slowly but wholly soluble. Boiling. More readily.	Slightly soluble.

Tests for Identity.	Quantitative Test.
On supersaturating the aqueous solution of the salt with a slight excess of water of ammonia, the color of the liquid is deepened, and a white, curdy precipitate is thrown down, which is soluble in ether and answers to the reactions of quinine (see Quinina). A small portion of the filtrate, when mixed with test-solution of ferrocyanide of potassium, does not produce a blue color or precipitate unless it is acidulated with hydrochloric acid. If another portion of the filtrate be deprived of its iron by boiling with an excess of potassa, the concentrated and cooled filtrate precipitated by test-solution of chloride of calcium, and the new filtrate heated to boiling, a white, granular precipitate will be produced. On heating the solution of the salt with potassa, no vapor of ammonia should be evolved. When strongly heated, the salt emits fumes having the odor of burnt sugar, and finally leaves a residue which should not have an alkaline reaction.	The salt contains 12 per cent. of dry quinine. It may be assayed as follows: Dissolve 4 Gm. of the scales in 30 C.c. of water, in a capsule, with the aid of heat. Cool, and transfer the solution to a glass separator, rinsing the capsule; add an aqueous solution of 0.5 Gm. of tartaric acid, and then solution of soda in decided excess. Extract the alkaloid by agitating the mixture with four successive portions of chloroform, each of 15 C.c. Separate the chloroformic layers, mix them, evaporate them in a weighed capsule, on a water-bath, and dry the residue at a temperature of 100° C. (212° F.). It should weigh 0.48 Gm.

Uses.—This is a valuable tonic combination, and is particularly useful in making pills, because of its slow solubility (see Ferri Citras). To supply the demand for a soluble form, the solution of citrate of iron and quinine was made officinal. The dose of the salt is from five to ten grains.

LIQUOR FERRI ET QUININÆ CITRATIS. *U.S.* **Solution of Citrate of Iron and Quinine.**

Citrate of Iron and Ammonium, 65 parts, or	**568 grains.**
Quinine, dried at 100° C. (212° F.), until it ceases to lose weight, 12 parts, or	**105 grains.**
Citric Acid, 28 parts, or	**245 grains.**
Alcohol, 30 parts, or	**6 fl. dr.**
Distilled Water, a sufficient quantity, To make 200 parts, or	**4 oz. av.**

Dissolve the Citrate of Iron and Ammonium in *two hundred parts* [or 4 fl. oz.] of Distilled Water, contained in a tared porcelain capsule, heat the solution to 60° C. (140° F.), on a water-bath, add the Citric Acid, and, when it is dissolved, add the Quinine, stirring the mixture until a perfect solution has been obtained. Evaporate this to *one hundred and sixty parts* [or 3 oz. av.], allow it to cool, add the Alcohol, and finally enough Distilled Water to make the solution weigh *two hundred parts* [or 4 oz. av.].

Liquor Ferri et Quininæ Citratis. *U.S.*	**Odor, Taste, and Reaction.**
A dark greenish-yellow to yellowish-brown liquid, transparent in thin layers. On supersaturating the diluted Solution with a slight excess of ammonia, the color of the liquid is deepened and a white, curdy precipitate is thrown down, which is soluble in ether and answers to the reaction of quinine (see Quinina).	Odorless; bitter and mildly ferruginous taste; slightly acid reaction.

Tests for Identity.	**Quantitative Test.**
A small portion of the filtrate, when mixed with test-solution of ferrocyanide of potassium, does not produce a blue color or precipitate, unless it is acidulated with hydrochloric acid. If another portion of the filtrate be deprived of its iron by boiling with an excess of potassa, the concentrated and cooled filtrate precipitated by test-solution of chloride of calcium, and the new filtrate heated to boiling, a white granular precipitate is produced. On heating the Solution with potassa, vapor of ammonia is evolved.	The Solution contains 6 per cent. of quinine. It may be assayed as follows: Dilute 8 Gm. of the Solution with water to 30 C.c., introduce it, with any rinsings, into a glass separator, add an aqueous solution of 0.5 Gm. of tartaric acid, and then solution of soda in decided excess. Extract the alkaloid by agitating the mixture with four successive portions of chloroform, each of 15 C.c. Separate the chloroformic layers, mix them, evaporate them in a weighed capsule, on a water-bath, and dry the residue at a temperature of 100° C. (212° F.). It should weigh 0.48 Gm.

Uses.—This solution was made officinal in order to satisfy a demand for a soluble form of citrate of iron and quinine. It is an excellent preparation, and it needs only to be known to be appreciated. It is just half the strength of the scaled salt, and the dose is therefore double,—from ten to twenty minims.

VINUM FERRI AMARUM. *U.S.* **Bitter Wine of Iron.**

This wine is made by mixing eight parts of solution of citrate of iron and quinine, twelve parts of tincture of sweet orange-peel, thirty-six parts of syrup, and forty-four parts of stronger white wine (see page

324). It is used as a mild ferruginous tonic, in doses of two to four teaspoonfuls.

FERRI ET STRYCHNINÆ CITRAS. *U. S.* **Citrate of Iron and Strychnine.**

	By measure.
Citrate of Iron and Ammonium, 98 parts, or	490 grains.
Strychnine, 1 part, or	5 grains.
Citric Acid, 1 part, or	5 grains.
Distilled Water, 120 parts, or	11 fl. dr.
To make 100 parts, or . . . about	1 oz. av.

Dissolve the Citrate of Iron and Ammonium in *one hundred parts* [or 9 fl. dr.] of Distilled Water, and the Strychnine, together with the Citric Acid, in *twenty parts* [or 2 fl. dr.] of Distilled Water. Mix the two solutions, evaporate the mixture, by means of a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stopped bottles, in a dark place.

This salt contains 1 per cent. of strychnine.

Ferri et Strychninæ Citras. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Transparent, garnet-red scales, deliquescent on exposure to air.	Odorless; bitter and slightly ferruginous taste; slightly acid reaction.	Readily and wholly soluble.	Slightly soluble.

Tests for Identity and Quantitative Test.

On heating the aqueous solution of the salt with solution of potassa, a brown-red precipitate is produced and vapor of ammonia is evolved. If 1 Gm. of the salt be dissolved in 4 C.c. of water, in a small test-tube, then 1 C.c. of solution of potassa added, and the mixture shaken with 2 C.c. of chloroform, the residue left on evaporating the chloroform will answer to the reactions of strychnine (see Strychnina). On adding test-solution of ferrocyanide of potassium to a dilute aqueous solution of the salt, no blue color or precipitate is produced unless the solution is acidulated with hydrochloric acid. If a solution of the salt be deprived of its iron by boiling with an excess of solution of potassa, the concentrated and cooled filtrate precipitated with test-solution of chloride of calcium, and the new filtrate heated to boiling, a white, granular precipitate will be produced. When strongly heated, the salt emits fumes having the odor of burnt sugar, and finally leaves a residue which should not have an alkaline reaction (fixed alkalies).

Uses.—This salt is used as a bitter ferruginous tonic, in doses of three to five grains.

SYRUPUS FERRI QUININÆ ET STRYCHNINÆ PHOSPHATUM.
Syrup of the Phosphates of Iron, Quinine, and Strychnine.

This syrup is made by dissolving one hundred and thirty-three parts each of phosphate of iron and quinine, four parts of strychnine, six thousand parts of sugar in eight hundred parts of phosphoric acid, and sufficient distilled water to make ten thousand parts (see page 263). It is sometimes known as *Easton's Syrup*. On keeping, it gradually deposits an insoluble precipitate containing a portion of the alkaloids. The dose is one to two teaspoonfuls.

FERRI ET AMMONII SULPHAS. *U.S.* **Sulphate of Iron and Ammonium.**

[AMMONIO-FERRIC SULPHATE. AMMONIO-FERRIC ALUM.]

$Fe_2(NH_4)_2(SO_4)_4.24H_2O$; 963.8.

Preparation.—Ammonio-ferric alum may be made by the process formerly officinal:

Take of Solution of Tersulphate of Iron 2 pints, Sulphate of Ammonium 4½ oz. troy. Heat the Solution of Tersulphate of Iron to the boiling point, add the Sulphate of Ammonium, stirring until it is dissolved, and set the liquid aside to crystallize. Wash the crystals quickly with very cold water, wrap them in bibulous paper, and dry them in the open air.

$$\underset{\text{Ferric Sulphate.}}{Fe_2 3SO_4} + \underset{\text{Ammonium Sulphate.}}{(NH_4)_2SO_4} = \underset{\text{Ammonio-ferric Sulphate.}}{Fe_2(NH_4)_2(SO_4)_4}.$$

It is well to choose the cold winter weather to prepare this salt, if it is possible to make a choice, as handsome crystals may then be obtained with little labor. This compound is not very stable, melting oftentimes in hot summer weather in its water of crystallization.

Ferri et Ammonii Sulphas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Pale violet, octahedral crystals, efflorescent on exposure to air. When strongly heated, the crystals fuse, lose their water of crystallization, swell up, and finally leave a pale brown residue.	Odorless; acid, styptic taste; slightly acid reaction.	Cold. 3 parts. Boiling. 0.8 part.	Insoluble.

Tests for Identity.	Impurities.	Test for Impurities.
The aqueous solution of the salt yields a blue precipitate with test-solution of ferrocyanide of potassium. With solution of potassa it affords a brown-red precipitate, and, if the mixture be heated, vapor of ammonia is evolved. With test-solution of chloride of barium it produces a white precipitate insoluble in hydrochloric acid.	Aluminium.	If all the iron be precipitated from a solution of the salt by heating with an excess of solution of potassa, the resulting filtrate, when mixed and heated with test-solution of chloride of ammonium in excess, should not yield a white, gelatinous precipitate.

Uses.—Iron alum is used as a styptic in saturated solution. It partakes more of the characteristics of an alum than of an iron salt.

FERRI ET AMMONII TARTRAS. *U.S.* **Tartrate of Iron and Ammonium.**

[AMMONIO-FERRIC TARTRATE.]

	By measure.
Solution of Tersulphate of Iron, 90 parts, or	13 fl. oz.
Tartaric Acid, 60 parts, or	12 oz. av.
Water of Ammonia, 72 parts, or	14½ fl. oz.
Carbonate of Ammonium,	
Distilled Water,	
Water, each, a sufficient quantity.	

To the Water of Ammonia, previously diluted with *one hundred and eighty parts* [or 2¼ pints] of cold Water, add, constantly stirring, the Solution of Tersulphate of Iron, previously diluted with *nine hundred parts* [or 10 pints] of cold Water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel and mix it intimately with *one thousand parts* [or 12 pints] of cold Water. Again drain it on the strainer and repeat the operation once, or oftener, until the washings cause but a slight cloudiness with test-solution of chloride of barium. Then allow the precipitate to drain completely. Dissolve one half of the Tartaric Acid in *one hundred and thirty parts* [or 1½ pints] of Distilled Water, neutralize the solution exactly with Carbonate of Ammonium, then add the other half of the Tartaric Acid and dissolve by the application of a gentle heat. Then, while continuing the heat, which should not exceed 60° C. (140° F.), add the magma of hydrated oxide of iron, in small portions at a time, until it is no longer dissolved. Filter the solution, evaporate it, at the before-mentioned temperature, to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stopped bottles, in a dark place.

Theoretically, this salt is supposed to have the following composition: $2(FeO)NH_4,C_4H_4O_6.3H_2O$. The formula indicates a double tartrate, in which the two basylous hydrogen atoms have been substituted by one of iron and one of ammonium radical. The scaled salts are, however, not definite compounds.

The object in this process is to form a compound in which ferric hydrate is made soluble by acid tartrate of ammonium, and the double salt tartrate of iron and ammonium is produced.

Ferri et Ammonii Tartras. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Transparent scales, varying in color from garnet-red to yellowish-brown, only slightly deliquescent.	Odorless; sweetish and slightly ferruginous taste; neutral reaction.	Very soluble.	Insoluble.

Tests for Identity.	Impurities.	Test for Impurities.
The aqueous solution of the salt is not precipitated, but is rendered darker, by water of ammonia. If heated with solution of potassa, it yields a brown-red precipitate, and vapor of ammonia is evolved. On adding test-solution of ferrocyanide of potassium to an aqueous solution of the salt, no blue color or precipitate is produced unless the solution is acidulated with hydrochloric acid. If a solution of the salt be deprived of iron by boiling with an excess of solution of soda, the concentrated and cooled filtrate, when supersaturated with acetic acid, will afford a white, crystalline precipitate.	Fixed Alkalies.	When strongly heated, the salt emits fumes having the odor of burnt sugar, and finally leaves a residue amounting to about 25 per cent. of the original weight, which should not have an alkaline reaction.

Uses.—This preparation is a mild chalybeate, the dose being ten to thirty grains.

FERRI ET POTASSII TARTRAS. *U. S.* **Tartrate of Iron and Potassium.**

[POTASSIO-FERRIC TARTRATE.]

Solution of Tersulphate of Iron, 12 parts, or	**13 fl. oz.**
Bitartrate of Potassium, 4 parts, or	**6 oz. av.**
Distilled Water, 32 parts, or	**3 pints.**
Water of Ammonia,	
Water, each, a sufficient quantity.	

To *ten parts* [or 15 fl. oz.] of Water of Ammonia, diluted with *twenty parts* [or 2 pints] of cold Water, add, constantly stirring, the Solution of Tersulphate of Iron, previously diluted with *one hundred parts* [or 9 pints] of cold Water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel and mix it intimately with *one hundred and twenty parts* [or 11 pints] of cold Water. Again drain it on the strainer, and repeat the operation once, or oftener, until the washings produce but a slight cloudiness with test-solution of chloride of barium. Put the drained precipitate into a stone-ware or porcelain vessel, add to it *thirty-two parts* [or 3 pints] of Distilled Water, heat the mixture, on a water-bath, to a temperature not exceeding 60° C. (140° F.), add the Bitartrate of Potassium, and stir until the hydrated oxide of iron is dissolved. Filter while hot, and let the filtrate stand in a cool, dark place for twenty-four hours; then stir it well with a porcelain or glass spatula, so that the precipitate which has formed in it may be thoroughly incorporated with the liquid. Now add, very cautiously, just enough Water of Ammonia to dissolve the precipitate, evaporate the solution, in a porcelain vessel, to the consistence of thick syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stopped bottles, in a dark place.

The intention in making tartrate of iron and potassium is to replace the hydrogen in the acid tartrate of potassium with iron, so that a double salt is produced like the tartrate of potassium and sodium.

Ferri et Potassii Tartras. *U. S.*	ODOR, TASTE, AND REACTION.	SOLUBILITY.	
		Water.	Alcohol.
Transparent, garnet-red scales, only slightly deliquescent. When strongly heated, the salt emits fumes having the odor of burnt sugar, and finally leaves a dark brown residue having a strongly alkaline reaction and effervescing with acids.	Odorless; sweetish, slightly ferruginous taste; neutral reaction.	Very soluble.	Insoluble.

TESTS FOR IDENTITY.

The aqueous solution of the salt is not precipitated, but is rendered darker, by water of ammonia. If heated with solution of potassa, it affords a brown-red precipitate, and a slight odor of ammonia is evolved. On adding test-solution of ferrocyanide of potassium to an aqueous solution of the salt, no blue color or precipitate is produced, unless the solution is acidulated with hydrochloric acid. If a solution of the salt be deprived of its iron, by boiling with an excess of solution of soda, the concentrated and cooled filtrate, when supersaturated with acetic acid, will afford a white, crystalline precipitate.

Uses.—This is a mild ferruginous tonic, and is given in doses of ten to thirty grains.

The French use this salt by making it into an olive-shaped ball, to which a loop of string is attached; a lead-pencil or any convenient stick is run through the loop, and the ball suspended over a glass containing wine or water, at such a height as to dip into the liquid, so as to dissolve the necessary quantity: the liquid is soon impregnated with the iron salt, and a second dose is prepared like the first by refilling the glass. This form is called "*Boule de Mars*," and furnishes a ready method of obtaining a mild chalybeate draught.

FERRI HYPOPHOSPHIS. *U. S.* Hypophosphite of Iron.

$Fe_2(H_2PO_2)_6$; 501.8. [FERRIC HYPOPHOSPHITE.]

Preparation.—This is among the hypophosphites brought into notice in consequence of their recommendation by Dr. Churchill in the treatment of phthisis, in which they were thought to be useful by the introduction of phosphorus into the system. This particular salt may be considered preferable to others when a marked condition of anæmia indicates a deficiency of iron in the tissues. It may be made by the action of hypophosphorous acid on carbonate of iron formed by precipitation from ferrous sulphate; but, as some difficulty has been found in obtaining this acid perfectly pure, preference has been given to the plan of double decomposition. This salt may be made by causing ferrous sulphate and calcium hypophosphite to react on each other in molecular proportions represented by 480 grains of crystallized ferrous sulphate and 326 grains of commercial hypophosphite,—in the latter an allowance of 10 per cent. being made for impurities ordinarily found in that salt. These quantities will yield 320 grains of ferric hypophosphite, and the reaction will be represented by the following formula:

$$\underset{\text{Calcium Hypophosphite.}}{Ca(H_2PO_2)_2} + \underset{\text{Ferrous Sulphate.}}{FeSO_4} = \underset{\text{Calcium Sulphate.}}{CaSO_4} + \underset{\text{Ferrous Hypophosphite.}}{Fe(H_2PO_2)_2}.$$

Calcium sulphate is precipitated, and ferrous hypophosphite is held in solution. In this condition the salt is a ferrous compound; but on evaporation the ferrous salt becomes ferric, and acquires the properties detailed in the Pharmacopœia.

Ferri Hypophosphis. *U. S.*	Odor and Taste.	Solubility.	
		Water.	Other Solvents.
A white or grayish-white powder, permanent in the air.	Odorless; nearly tasteless.	Slightly soluble, more readily so in presence of hypophosphorous acid.	Freely soluble in hydrochloric acid or in solution of citrate of sodium, forming with the latter a green solution.

Tests for Identity.	Impurities.	Tests for Impurities.
When strongly heated in a dry test-tube, the salt evolves a spontaneously inflammable gas (phosphoretted hydrogen), and, on ignition, leaves behind ferric pyrophosphate. The salt is readily oxidized by nitric acid or other oxidizing agents.	Ferric Phosphate.	The salt should be completely soluble in acetic acid.
	Calcium.	A solution of the salt in acetic acid, when mixed with test-solution of oxalate of ammonium, should not afford a white precipitate soluble in hydrochloric acid.

Uses.—Hypophosphite of iron is given in anæmia and in cases of defective nerve-nutrition: it is administered in the form of pills, powders, or syrup. The dose is from five to ten grains.

FERRI IODIDUM SACCHARATUM. *U.S.* Saccharated Iodide of Iron.

[Saccharated Ferrous Iodide.]

Iron, in the form of fine wire, and cut into small pieces, 6 parts, or . .	30 grains.
Iodine, 17 parts, or	85 grains.
Distilled Water, 20 parts, or	1½ fl. dr.
Sugar of Milk, 80 parts, or	400 grains.

Mix the Iron, Iodine, and Distilled Water in a flask of thin glass, shake the mixture occasionally until the reaction ceases and the solution has acquired a green color and lost the smell of Iodine; then filter it through a wetted filter into a porcelain capsule containing *forty parts* [or 200 gr.] of Sugar of Milk. Rinse the flask and Iron Wire with a little Distilled Water, pass the rinsings through the filter into the capsule, and evaporate, on a water-bath, constantly stirring, until a dry mass remains. Transfer the mass quickly to a heated iron mortar containing the remainder of the Sugar of Milk, and reduce the whole to powder. Transfer the powder at once to small, well-dried bottles, which must be securely stopped, and kept in a cool and dark place.

This process requires first the production of ferrous iodide (see Syrupus Ferri Iodidi, page 263); the solution is then evaporated quickly and granulated, diluted with sugar of milk, powdered, and at once introduced into bottles. This powder, upon keeping, is very apt to become oxidized and show the presence of free iodine. When of a brown color it should not be dispensed.

Ferri Iodidum Saccharatum. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A yellowish-white or grayish powder, very hygroscopic. Soluble in 7 parts of water at 15° C. (59° F.), forming an almost clear solution; only partially soluble in alcohol.	Odorless; sweetish, ferruginous taste; slightly acid reaction.	7 parts, forming an almost clear solution.	Partially soluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution yields a blue precipitate with test-solution of ferricyanide of potassium. If mixed with some gelatinized starch and afterwards with a little chlorine water, the solution assumes a deep blue color.	Salts or Alkalies.	When strongly heated, the compound swells up, chars, evolves the odor of iodine and of burnt sugar, and, on ignition, leaves a residue, which should yield nothing soluble to water.
On mixing an aqueous solution of 5 Gm. of Saccharated Iodide of Iron with a solution of 1 Gm. of nitrate of silver, and filtering, the filtrate should still produce a precipitate or cloudiness with test-solution of nitrate of silver (presence of at least 20 per cent. of ferrous iodide).	Free Iodine.	The color produced by adding to the salt some gelatinized starch, and afterwards a little chlorine water, should not be developed in the aqueous solution by gelatinized starch alone.

SYRUPUS FERRI IODIDI. *U.S.* Syrup of Iodide of Iron.

A syrupy liquid containing 10 per cent. of Ferrous Iodide [FeI_2; 309.1].

This syrup is prepared by forming a solution of ferrous iodide by acting on iron wire with iodine in the presence of water; the green solution of ferrous iodide is then protected by the addition of sugar, and the mixture is boiled and strained, and filled into small bottles accessible to daylight. The object of exposing the syrup to daylight is to prevent the separation of free iodine, to which the irritant action is due, the syrup being prone to decomposition and discoloration from this separation: when iodine is diffused through water and is exposed to light, colorless hydriodic acid is formed, and this is measurably protected from change through the intervention of the syrup. (See Syrupus Acidi Hydriodici, page 259.) The dose of this syrup is from ten to thirty minims: it should be largely diluted, and sucked through a glass tube, to protect the teeth from injury.

SYRUPUS FERRI BROMIDI. *U.S.* Syrup of Bromide of Iron.

A syrupy liquid containing 10 per cent. of Ferrous Bromide [$FeBr_2$; 215.5].

This syrup, like the preceding, is a solution of a ferrous salt preserved from decomposition by the use of sugar. Ferrous bromide is produced by the action of bromine upon iron in water, and the green solution is added to sugar, just as in the case of the syrup of ferrous iodide. It is given in doses of thirty to sixty minims.

PILULÆ FERRI IODIDI. *U.S.* Pills of Iodide of Iron.

The liability to decomposition of ferrous iodide has led to various forms of administration which will present it unaltered. The officinal pills of iodide of iron are directed to be coated with an ethereal solution of tolu to preserve them from change. The pills contain ferrous iodide, sugar, extract of glycyrrhiza, glycyrrhiza, and acacia. There is in each pill nearly one grain of ferrous iodide. Ferrous iodide is a valuable salt in diseases attended with anæmia which require the use of an alterative. The dose is one or two pills.

FERRI LACTAS. *U.S.* Lactate of Iron.

$Fe(C_3H_5O_3)_2.3H_2O$; 287.9. [FERROUS LACTATE.]

Preparation.—This salt may be made by the former officinal process: Take of Lactic Acid, 1 fl. oz.; Iron, in the form of filings, 240 grains; Distilled Water, a sufficient quantity. Mix the Acid with a pint of Distilled Water in an iron vessel, add the Iron, and digest the mixture on a water-bath, supplying Distilled Water, from time to time, to preserve the measure. When the action has ceased, filter the solution, while hot, into a porcelain capsule, and set it aside to crystallize. At the end of forty-eight hours, decant the liquid, wash the crystals with a little alcohol, and dry them on bibulous paper. By evaporating the mother-water in an iron vessel to one-half, filtering while hot, and setting the liquid aside, more crystals may be obtained.

$$\underset{\text{Iron.}}{Fe_2} + \underset{\text{Lactic Acid.}}{4HC_3H_5O_3} = \underset{\text{Ferrous Lactate.}}{2Fe(C_3H_5O_3)_2} + \underset{\text{Hydrogen.}}{H_4}.$$

Ferri Lactas. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Pale greenish-white, crystalline crusts or grains, permanent in the air. When heated on platinum foil, the salt froths up, gives out thick, white, acrid fumes, and chars, a brown-red residue being finally left.	Odorless; mild, sweetish, ferruginous taste; slightly acid reaction.	Cold. 40 parts. Boiling. 12 parts.	Almost insoluble.	Freely soluble in solution of citrate of sodium, yielding a green solution.

Tests for Identity.	Impurities.	Test for Impurities.
The aqueous solution yields a blue precipitate with test-solution of ferricyanide of potassium. If the salt be boiled for fifteen minutes with nitric acid of the sp. gr. 1.200, white, granular mucic acid will be deposited on cooling the liquid.	Sulphate, Citrate, Tartrate.	An aqueous solution of the salt should not be rendered more than faintly opalescent by test-solution of acetate of lead.

Uses.—Lactate of iron is used as a chalybeate because it is believed to be more readily assimilated than other iron salts. It is given in doses of one to five grains.

FERRI OXALAS. *U.S.* Oxalate of Iron.

$FeC_2O_4.H_2O$; 161.9. [FERROUS OXALATE.]

Preparation.—The former officinal process may be used in making this salt:

Take of Sulphate of Iron, 2 oz. troy; Oxalic Acid, 436 grains; Distilled Water, a sufficient quantity. Dissolve the Sulphate of Iron in 30 fl. oz., and the Oxalic Acid in 15 fl. oz. of Distilled Water. Filter the solutions, and, having mixed them with agitation, set aside the mixture until the precipitate is deposited. Decant the clear liquid, wash the precipitate until the washings cease to redden litmus, and dry it with a gentle heat.

The insolubility of this salt is utilized in its preparation: ferrous sulphate and oxalic acid are both soluble, but when their solutions are mixed insoluble ferrous oxalate is precipitated, and sulphuric acid is set free.

Ferri Oxalas. *U.S.*	Odor and Taste.	Solubility.	
		Water.	Other Solvents.
A pale yellow, or lemon-yellow, crystalline powder, permanent in the air. When heated in contact with air, it decomposes with a faint combustion, and, on ignition, leaves a residue amounting to not less than 49.3 per cent. of the original weight.	Odorless; nearly tasteless.	Cold. Very slightly soluble. Boiling. Very slightly soluble.	Soluble in cold, concentrated hydrochloric acid, and in hot, diluted sulphuric acid.

Tests for Identity.

On heating the salt with excess of test-solution of carbonate of sodium, it is decomposed, yielding a precipitate, which, when dissolved in diluted hydrochloric acid, affords a blue precipitate with test-solution of ferricyanide of potassium, and a filtrate which, when supersaturated with acetic acid, yields, with test-solution of chloride of calcium, a white precipitate soluble in hydrochloric acid.

Uses.—It is doubtful whether the introduction of this salt has served a useful purpose. It is very nearly insoluble, and, although on this account it has the advantage of being nearly tasteless, it is questionable whether sufficient dissolves in the stomach to have any perceptible effect. The dose is two to three grains.

FERRI OXIDUM HYDRATUM. *U.S.* Hydrated Oxide of Iron.

$Fe_2(HO)_6$; 213.8. [Ferric Hydrate.]

	By measure.
Solution of Tersulphate of Iron, 10 parts, or	3 fl. oz.
Water of Ammonia, 8 parts, or	3¼ fl. oz.
Water, a sufficient quantity.	

To the Water of Ammonia, previously diluted with *twenty parts* [or 8 fl. oz.] of cold Water, add, constantly stirring, the Solution of Tersulphate of Iron, previously diluted with *one hundred parts* [or 2½ pints] of cold Water. Pour the whole on a wet muslin strainer, and allow the precipitate to drain; then return it to the vessel and mix it intimately with *one hundred and twenty parts* [or 3 pints] of cold Water. Again drain it on the strainer and repeat the operation. Lastly, mix the precipitate with enough cold Water to make the mixture weigh *twenty parts* [or 8 oz. av.]. When Hydrated Oxide of Iron is to be made in haste for use as an antidote, the washing may be performed more quickly, though less perfectly, by pressing the strainer forcibly with the hands until no more liquid passes, and then adding enough Water to make the whole weigh about *twenty parts* [or 8 oz. av.].

Note.—The ingredients for preparing Hydrated Oxide of Iron as an antidote should always be kept on hand, in bottles holding, respectively, about 10 oz. troy or 300 Gm. of Solution of Tersulphate of Iron, and about 8 oz. troy or 240 Gm. of Water of Ammonia.

The reaction is as follows:

$$\underset{\text{Ferric Sulphate.}}{Fe_2 3SO_4} + \underset{\text{Ammonium Hydrate.}}{6NH_4HO} = \underset{\text{Ferric Hydrate.}}{Fe_2(HO)_6} + \underset{\text{Ammonium Sulphate.}}{3(NH_4)_2SO_4}.$$

Water of ammonia is preferred as the precipitant, because an excess is easily detected by the odor, and the salt formed is easily washed out.

Uses.—This compound is used as the basis of several iron salts, citrate, tartrate, etc., and also as the antidote to poisoning by arsenic. For the latter purpose it should be administered freely. It acts by producing insoluble ferrous arseniate.

$$\underset{\text{Ferric Hydrate.}}{2Fe_2(HO)_6} + \underset{\text{Arsenious Oxide.}}{As_2O_3} = \underset{\text{Ferrous Arseniate.}}{Fe_3(AsO_4)_2} + \underset{\text{Ferrous Hydrate.}}{Fe(HO)_2} + \underset{\text{Water.}}{5H_2O.}$$

It should never be kept on hand, as it decomposes even when kept under water: the ingredients should always be kept already weighed out, placed in suitable bottles, *and in an accessible and well-known place in the store*, so that if wanted quickly it can be made without the unnecessary loss of a moment's time.

FERRI OXIDUM HYDRATUM CUM MAGNESIA. *U.S.* Hydrated Oxide of Iron with Magnesia.

Solution of Tersulphate of Iron, 1000 grains (65.00 Gm.), or .	**1 fl. oz. 6 fl. dr.**
Magnesia, 150 grains (10.00 Gm.), or	**150 grains.**
Water, a sufficient quantity,	
To make	**2 pints.**

Mix the Solution of Tersulphate of Iron with twice its weight (or volume) of Water, and keep the mixture in a well-stopped bottle. Rub the Magnesia with Water to a smooth and thin mixture, transfer this to a bottle capable of holding *thirty-two fluidounces*, or about *one litre*, and fill it up with Water. When the preparation is wanted for use, mix the two liquids by adding the Magnesia mixture, gradually, to the Iron solution, and shake them together until a homogeneous mass results.

Note.—The diluted Solution of Tersulphate of Iron and the mixture of Magnesia with Water should always be kept on hand, ready for immediate use.

Uses.—This preparation furnishes a ready and efficient antidote against arsenious acid. Ferric hydrate is produced when the mixture of magnesia is added to the diluted solution of tersulphate of iron, and, as the magnesia is in excess and acidity thus prevented, no harm can result from not separating the by-products of the reaction. It contains in addition magnesium sulphate and hydrate. It has been shown that no soluble compound with arsenic is formed when it is used as an antidote, and the presence of the magnesium salts, from a therapeutical point of view, is not at all objectionable.

FERRI PHOSPHAS. *U.S.* Phosphate of Iron.

[Ferric Phosphate.]

Citrate of Iron, 5 parts, or	**10 oz. av.**
Phosphate of Sodium, 6 parts, or	**12 oz. av.**
Distilled Water, 10 parts, or	**19 fl. oz.**

Dissolve the Citrate of Iron in the Distilled Water by heating on a water-bath. To this solution add the Phosphate of Sodium, and stir

constantly until it is dissolved. Evaporate the solution, at a temperature not exceeding 60° C. (140° F.), to the consistence of thick syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stopped bottles, in a dark place.

This is a scaled salt, and very different from the insoluble slate-colored powder of phosphate of iron formerly officinal. It is not a definite chemical compound, but is sometimes termed sodio-ferric citro-phosphate. It greatly resembles the officinal ferric pyrophosphate.

Ferri Phosphas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Thin, bright green, transparent scales, permanent in dry air when excluded from light, but turning dark on exposure to light. The aqueous solution of the salt is rendered blue by test-solution of ferrocyanide of potassium, but does not yield a blue precipitate with this reagent, unless it has been acidulated with hydrochloric acid.	Odorless; acidulous, slightly saline taste; slightly acid reaction.	Freely and completely soluble.	Insoluble.

Tests for Identity.

When heated with solution of potassa in excess, a brown-red precipitate is thrown down, and the filtrate, after being supersaturated with acetic acid, yields a light yellow precipitate with test-solution of nitrate of silver (difference from pyrophosphate).
100 parts of the salt represent about 13.5 parts of metallic iron.

Uses.—This is a mild and safe ferruginous tonic. It is given in doses of five to ten grains.

FERRI PYROPHOSPHAS. *U.S.* Pyrophosphate of Iron.

[Ferric Pyrophosphate.]

Citrate of Iron, 9 parts, or	9 oz. av.
Pyrophosphate of Sodium, 10 parts, or	10 oz. av.
Distilled Water, 18 parts, or	17 fl. oz.

Dissolve the Citrate of Iron in the Distilled Water by heating, on a water-bath. To this solution add the Pyrophosphate of Sodium and stir constantly until it is dissolved. Evaporate the solution, at a temperature not exceeding 60° C. (140° F.), to the consistence of thick syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stopped bottles, in a dark place.

This compound is a mixture of several salts,—sodio-ferric pyrophosphate, sodio-ferric citrate, and ferric citrate. It differs from the salt formerly officinal, which was the insoluble ferric pyrophosphate, $Fe_4 3P_2O_7$, dissolved in solution of ammonium citrate: the ammonium salt is less stable than the sodium compound, being slowly decomposed on exposure to the air, and the process yielded an unsatisfactory product.

Ferri Pyrophosphas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Thin, apple-green, transparent scales, permanent in dry air when excluded from light, but turning dark on exposure to light. The aqueous solution of the salt is rendered blue by test-solution of ferrocyanide of potassium, but does not yield a blue precipitate with this reagent, unless it has been acidulated with hydrochloric acid.	Odorless; acidulous, slightly saline taste; slightly acid reaction.	Freely and completely soluble.	Insoluble.

Tests for Identity.

When heated with solution of potassa in excess, a brown-red precipitate is thrown down, and the filtrate, after being supersaturated with acetic acid, yields a white precipitate with test-solution of nitrate of silver (difference from phosphate).
100 parts of the salt represent about 11.5 parts of metallic iron.

Uses.—This is one of the best of the mild ferruginous preparations. It is very largely used on account of its solubility and the ease with which it can be administered either in pills or in solution. The dose is two to five grains.

FERRI SULPHAS. *U. S.* Sulphate of Iron.

$FeSO_4.7H_2O$; 277.9. [Ferrous Sulphate.]

Preparation.—This salt is rarely made by the pharmacist, because the commercial article is furnished much more cheaply than the salt made on the small scale. The following is the British process:

Take of Iron Wire 4 oz. av.; Sulphuric Acid 4 fl. oz. [Imperial measure]; Distilled Water 1½ pints [Imp. meas.]. Pour the Water on the Iron placed in a porcelain dish, add the Sulphuric Acid, and, when the disengagement of gas has nearly ceased, boil for ten minutes. Filter now through paper, and, after the lapse of twenty-four hours, separate the crystals which have been deposited from the solution. Let these be dried on filtering paper placed on porous bricks, and be preserved in a stoppered bottle.

The salt is a by-product in the manufacture of hydrogen, the following being the reaction:

$$\underset{\text{Iron.}}{Fe_2} + \underset{\substack{\text{Sulphuric}\\\text{Acid.}}}{2H_2SO_4} = \underset{\substack{\text{Ferrous}\\\text{Sulphate.}}}{2FeSO_4} + \underset{\text{Hydrogen.}}{4H}.$$

Ferri Sulphas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Large, pale bluish-green, monoclinic prisms, efflorescent and absorbing oxygen on exposure to air. When quickly heated, the crystals fuse. When slowly heated to 115° C. (239° F.), they fall to powder and lose 38.86 per cent. of their weight (water of crystallization).	Odorless; saline, styptic taste; acid reaction.	Cold. 1.8 parts. Boiling. 0.3 part.	Insoluble.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The aqueous solution of the salt affords a blue precipitate with test-solution of ferricyanide of potassium, and a white precipitate, insoluble in hydrochloric acid, with test-solution of chloride of barium. If 4.167 Gm. of Sulphate of Iron are dissolved in water acidified with diluted sulphuric acid, and the solution treated with volumetric solution of bichromate of potassium, until a drop no longer gives a blue color with test-solution of ferricyanide of potassium, the required number of C.c. of the volumetric solution, multiplied by *two*, equals the percentage of unoxidized ferrous sulphate in crystals.	Ferric Salt.	When the salt is acidulated with sulphuric acid, the solution should yield not more than a faint white turbidity with hydrosulphuric acid.
	Copper.	When acidulated with sulphuric acid, the solution should yield no colored precipitate.

Uses.—This is a very astringent iron salt. When used internally, the exsiccated salt is preferred. The impure ferrous sulphate, called *copperas*,[1] is used as a disinfectant. The dose of the sulphate is one to two grains.

FERRI SULPHAS EXSICCATUS. *U.S.* Dried Sulphate of Iron.

$FeSO_4.H_2O$; 169.9. [Dried Ferrous Sulphate.]

Sulphate of Iron, in coarse powder, *a convenient quantity.* Expose the Sulphate of Iron, in an unglazed earthen vessel, to a moderate heat, occasionally stirring, until it has effloresced. Then increase the heat to 149° C. (300° F.), and maintain it at that temperature until the salt ceases to lose weight. Lastly, reduce the residue to fine powder, and keep it in well-stopped bottles.

This process does not deprive the ferrous sulphate of all of its water of crystallization, about 15 per cent. being retained. One hundred parts of crystallized sulphate of iron yield about 61 per cent. of the dried salt.

Uses.—Dried sulphate of iron is a grayish-white powder, and is principally used in making pills, the crystallized sulphate being unfitted for the purpose on account of the large proportion of water that it contains. Five grains of the crystals are represented by three grains of the dried sulphate. It is used in the officinal pills of aloes and iron.

FERRI SULPHAS PRÆCIPITATUS. *U.S.* Precipitated Sulphate of Iron.

$FeSO_4.7H_2O$; 277.9. [Precipitated Ferrous Sulphate.]

Sulphate of Iron, 100 parts, or	16 oz. av.
Distilled Water, 170 parts, or	26 fl. oz.
Sulphuric Acid, 4 parts, or	2½ fl. dr.
Alcohol, a sufficient quantity.	

Dissolve the Sulphate of Iron in the Distilled Water, previously mixed with the Sulphuric Acid, and filter the solution. Allow the

[1] This unfortunate synonyme, "*copperas*," has led to a great many errors, through the impression that this salt must contain copper. It is often confounded with the poisonous salt sulphate of copper, or blue vitriol, and they have been substituted for each other. (See Synonymes, page 29.)

filtrate to become cold, pour it gradually, with constant stirring, into an equal volume of Alcohol [or 2 pints], and set the mixture aside for one day in a well-covered vessel. Drain the crystalline powder, which has settled, in a funnel, wash it with Alcohol, until the washings cease to redden blue litmus paper, fold it in a piece of muslin and press it gently. Finally, spread the powder on bibulous paper and dry it quickly in the sunlight, or in a dry-room, at the ordinary temperature, and keep it in well-stopped bottles.

Ferrous sulphate is insoluble in alcohol: hence, if a strong aqueous solution is poured into alcohol, it is precipitated in the form of a granular crystalline powder.

Uses.—Precipitated sulphate of iron should be used in preference to the large crystals at the prescription counter: the precipitation in alcohol not only furnishes it in a convenient form, but the soluble impurities are washed out. It is much less liable to oxidation and change than the ordinary crystallized sulphate.

Ferri Sulphas Præcipitatus. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A very pale bluish-green, crystalline powder, efflorescent in dry air, but, when in contact with moisture, becoming gradually oxidized. It should respond to the same reactions and tests as sulphate of iron (see Ferri Sulphas).	Odorless; saline, styptic taste; acid reaction.	Cold. 1.8 parts. Boiling. 0.3 part.	Insoluble.

Quantitative Test.

If 4.167 Gm. of Precipitated Sulphate of Iron are dissolved in water acidified with diluted sulphuric acid, and the solution treated with volumetric solution of bichromate of potassium, until a drop no longer gives a blue color with test-solution of ferricyanide of potassium, the required number of C.c. of the volumetric solution, multiplied by *two*, equals the percentage of unoxidized ferrous sulphate in crystals.

FERRI VALERIANAS. *U.S.* Valerianate of Iron.

$Fe_2(C_5H_9O_2)_6$; 717.8. [Ferric Valerianate.]

Preparation.—Ferric valerianate may be made by mixing solutions of ferric sulphate and sodium valerianate: double decomposition results in the precipitation of ferric valerianate, whilst sodium sulphate remains in solution.

Ferri Valerianas. *U.S.*	Odor and Taste.	Solubility.	
		Water.	Alcohol.
A dark tile-red, amorphous powder, permanent in dry air.	Faint odor of valerianic acid; mildly styptic taste.	Cold. Insoluble. Boiling. Is decomposed, setting free the valerianic acid and leaving ferric hydrate.	Readily soluble.

Tests for Identity.
When slowly heated, the salt parts with its acid without fusing, but, when rapidly heated, it fuses and gives off inflammable vapors having the odor of butyric acid. On ignition, ferric oxide remains. Mineral acids decompose the Valerianate, forming the respective ferric salts and liberating valerianic acid.

Uses.—This salt is of very little use in pharmacy or medicine: it is rarely prescribed. The dose is one to ten grains.

TINCTURA FERRI ACETATIS. *U. S.* Tincture of Acetate of Iron.

[Tincture of Ferric Acetate.]

This tincture is made by mixing fifty parts of solution of acetate of iron, thirty parts of alcohol, and twenty parts of acetic ether (see page 310). It decomposes in time, depositing an insoluble reddish-brown precipitate. The dose is from fifteen to thirty minims.

LIQUOR FERRI ACETATIS. *U. S.* Solution of Acetate of Iron.

An aqueous solution of Ferric Acetate [$Fe_2(C_2H_3O_2)_6$; 465.8], containing 33 per cent. of the anhydrous salt.

Solution of Tersulphate of Iron, 100 parts, or	14½ fl. oz.
Glacial Acetic Acid, 26 parts, or	4¾ fl. oz.
Water of Ammonia, 80 parts, or	16 fl. oz.
Water,	
Distilled Water, each, a sufficient quantity,	
To make 100 parts, or	1 pint.

To the Water of Ammonia diluted with *two hundred parts* [or 2½ pints] of cold Water, add, constantly stirring, the solution of Tersulphate of Iron, previously diluted with *three hundred and fifty parts* [or 4 pints] of cold Water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel, and mix it intimately with *six hundred parts* (or 7 pints) of cold water, again drain it on the strainer, and repeat the operation, until the washings cause but a slight cloudiness with test-solution of chloride of barium. Then allow the excess of Water to drain off, and press the precipitate, folded in the strainer, until its weight is reduced to *seventy parts* [or 14 oz. av.] or less. Add the precipitate to the Glacial Acetic Acid contained in a capacious porcelain capsule, and stir occasionally, until the oxide is entirely dissolved. Finally, add enough cold, Distilled Water to make the solution weigh *one hundred parts* [or measure 1 pint], and filter, if necessary. Solution of Acetate of Iron should be kept in well-stopped bottles, protected from light.

Liquor Ferri Acetatis. *U. S.*	Odor, Taste, and Reaction.
A dark red-brown, transparent liquid. Sp. gr. 1.160.	Acetous odor; sweetish, faintly styptic taste; slightly acid reaction.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The diluted Solution affords a brown-red precipitate with water of ammonia, and a blue precipitate with test-solution of ferrocyanide of potassium. When heated with sulphuric acid, the solution evolves acetous vapors.	Zinc, Copper.	If the iron be completely precipitated from the Solution by an excess of ammonia, a portion of the filtrate should not yield a white or a dark-colored precipitate with hydrosulphuric acid.
	Fixed Alkalies.	The Solution, after the iron has been completely precipitated from it by an excess of ammonia, should leave no fixed residue on evaporation and gentle ignition.
10 Gm. of the Solution mixed with a few drops of nitric acid, carefully evaporated and ignited, should yield a residue weighing 1.13 Gm.	Ferrous Salt.	A few drops of the Solution added to freshly prepared test-solution of ferricyanide of potassium should impart to it a pure greenish-brown color without a trace of blue.

Uses.—This solution has been made officinal, principally because it is used in making the tincture of acetate of iron. The dose is five minims.

MISTURA FERRI ET AMMONII ACETATIS. *U.S.* Mixture of Acetate of Iron and Ammonium.

This so-called mixture is a valuable solution. It is made by mixing two parts of tincture of chloride of iron, three parts of diluted acetic acid, twenty parts of solution of acetate of ammonium, ten parts of elixir of orange, fifteen parts of syrup, and fifty parts of water. It is a mild ferruginous solution, of very pleasant taste, and is often known as Basham's mixture. It is given in doses of four fluidrachms to one fluidounce.

LIQUOR FERRI NITRATIS. *U.S.* Solution of Nitrate of Iron.

[Solution of Ferric Nitrate.]

An aqueous solution of Ferric Nitrate [$Fe_2(NO_3)_6$; 483.8], containing about 6 per cent. of the anhydrous salt.

Solution of Tersulphate of Iron, 18 parts, or	2 fl. oz. 5 fl. dr.
Water of Ammonia, 15 parts, or	3 fl. oz.
Nitric Acid, 7 parts, or	7½ fl. dr.
Distilled Water,	
Water, each, a sufficient quantity,	
To make 100 parts, or	20 oz. av.

To the Water of Ammonia previously diluted with *forty parts* [or 8 fl. oz.] of cold Water, add, constantly stirring, the Solution of Tersulphate of Iron, previously diluted with *one hundred parts* [or 20 fl. oz.] of cold Water. Pour the whole on a wet muslin strainer, allow the precipitate to drain, then return it to the vessel and mix it intimately with *one hundred parts* [or 20 fl. oz.] of cold Water. Again drain it on a strainer and repeat the operation, until the washings cause but a very slight cloudiness with test-solution of chloride of barium. Then allow the excess of Water to drain off, transfer the precipitate to a capacious (tared) porcelain dish, and add the Nitric Acid, stirring till a clear solution is obtained. Finally, add enough Distilled Water to make the solution weigh *one hundred parts* [or 20 oz. av.].

This solution is simply made by dissolving moist ferric hydrate in nitric acid.

Liquor Ferri Nitratis. *U.S.*	Test for Identity and Quantitative Test.
A transparent, amber-colored or reddish liquid, without odor, having an acid, strongly styptic taste, and an acid reaction. Sp. gr. 1.050. The Solution affords a brown-red precipitate with water of ammonia, and a blue precipitate with test-solution of ferrocyanide of potassium.	If a clear crystal of ferrous sulphate be added to a cooled mixture of equal volumes of concentrated sulphuric acid and of the Solution, the crystal rapidly becomes brown and surrounded by a brownish-black zone. 10 Gm. of the Solution, when precipitated by water of ammonia in excess, yield a precipitate, which, when washed, dried, and ignited, should weigh 0.2 Gm.

Uses.—This solution is tonic and astringent. It is given in doses of five to ten minims.

LIQUOR FERRI SUBSULPHATIS. *U.S.* **Solution of Subsulphate of Iron.**

[Solution of Basic Ferric Sulphate. Monsel's Solution.]

An aqueous solution of Basic Ferric Sulphate [$Fe_4O(SO_4)_5$; 719.6], containing 48.7 per cent. of the salt.

Sulphate of Iron, 77 parts, or	13 oz. av.
Sulphuric Acid, 7 parts, or	1 oz. av. 72 gr.
Nitric Acid,	
Distilled Water, each, a sufficient quantity,	
To make 114 parts, or	19 oz. av.

Mix the Sulphuric Acid with *eleven parts* [or 1 oz. av. 360 gr.] of Nitric Acid and *fifty parts* [or 8 fl. oz.] of Distilled Water in a capacious porcelain capsule, and, having heated the mixture to the boiling point, add the Sulphate of Iron (one-fourth of it at a time), stirring after each addition until effervescence ceases. Should the addition of a few drops of Nitric Acid cause a further evolution of red fumes, cautiously add Nitric Acid until red fumes cease to be evolved. Then keep the solution in brisk ebullition until nitrous vapors are no longer perceptible, and the liquid assumes a deep ruby-red tint. Lastly, add enough Distilled Water to make the solution weigh *one hundred and fourteen parts* [or 19 oz. av.]. Solution of Subsulphate of Iron is to be dispensed when Solution of Persulphate of Iron is prescribed by the physician.

When ferrous sulphate is added to a hot mixture of nitric and sulphuric acids, a copious evolution of reddish-yellow vapors of nitrogen monoxide takes place, and the iron assumes a blackish tint, due to the formation of a compound of the ferrous sulphate with the nitric oxide. This black color disappears under the influence of heat, and, when effervescence ceases, the dark reddish-brown liquid is left which is widely known as *Monsel's Solution* (see Liquor Ferri Tersulphatis).

Liquor Ferri Subsulphatis. *U.S.*	Odor, Taste, and Reaction.	Solubility.
A dark reddish-brown, almost syrupy liquid. Sp. gr. 1.555. The diluted Solution affords a brown-red precipitate with water of ammonia, a blue one with test-solution of ferrocyanide of potassium, and a white one, insoluble in hydrochloric acid, with test-solution of chloride of barium.	Odorless, or nearly so; extremely astringent taste, free from causticity; acid reaction.	Miscible in all proportions with water and alcohol without decomposition.

Test for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
On slowly mixing 2 volumes of the Solution with 1 volume of concentrated sulphuric acid, in a beaker, the mixture separates a solid, white mass on standing (difference from tersulphate). 10 Gm. of the Solution, when completely precipitated by excess of water of ammonia, yield a precipitate, which, when washed, dried, and ignited, should weigh 1.938 Gm.	Nitric Acid.	On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the Solution, the crystal should not become brown, nor should there be a brownish-black zone developed around it.
	Ferrous Salt.	A few drops added to freshly prepared test-solution of ferricyanide of potassium should impart to it a pure, greenish-brown color, without a trace of blue.

Uses.—This preparation is probably the most valuable officinal styptic solution. It is less irritating than the solution of the tersulphate, owing to the smaller proportion of sulphuric acid. It is used externally in stopping hemorrhages, and internally in doses of three to six minims, largely diluted with water.

LIQUOR FERRI TERSULPHATIS. *U.S.* **Solution of Tersulphate of Iron.**

[Solution of Normal Ferric Sulphate.]

An aqueous solution of Normal Ferric Sulphate [$Fe_2(SO_4)_3$; 399.8], containing 28.7 per cent. of the salt.

Sulphate of Iron, 80 parts, or	8 oz. av.
Sulphuric Acid, 15 parts, or	1½ oz. av.
Nitric Acid,	
Distilled Water, each, a sufficient quantity,	
To make 200 parts, or	20 oz. av.

Mix the Sulphuric Acid with *eleven parts* [or 1 oz. av. 45 gr.] of Nitric Acid and with *fifty parts* [or 5 fl. oz.] of Distilled Water in a capacious porcelain capsule, and, having heated the mixture to the boiling point, add the Sulphate of Iron (one-fourth of it at a time), stirring, after each addition, until effervescence ceases. Should the addition of a few drops of Nitric Acid cause a further evolution of red fumes, cautiously add Nitric Acid until red fumes cease to be evolved. Then continue the heat until the solution acquires a reddish-brown color and is free from nitrous odor. Lastly, add enough Distilled Water to make the whole weigh *two hundred parts* [or 20 oz. av.].

This solution differs from the solution of subsulphate of iron merely in containing a larger proportion of sulphuric acid. It has the sp. gr. 1.320, and is a solution of the *true* persulphate $Fe_2(SO_4)_3$, or normal ferric sulphate. Solution of persulphate of iron is the name under which Monsel's solution is erroneously prescribed. The latter is a solution of a subsalt, $Fe_4O(SO_4)_5$. The reaction is as follows:

$$\underset{\text{Ferrous Sulphate.}}{6FeSO_4} + \underset{\text{Sulphuric Acid.}}{3H_2SO_4} + \underset{\text{Nitric Acid.}}{2HNO_3} = \underset{\text{Ferric Sulphate.}}{3(Fe_23SO_4)} + \underset{\text{Nitrogen Monoxide.}}{2NO} + \underset{\text{Water.}}{4H_2O}.$$

Liquor Ferri Tersulphatis. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A dark reddish-brown liquid. The diluted Solution affords a brown-red precipitate with water of ammonia, a blue one with test-solution of ferrocyanide of potassium, and a white one, insoluble in hydrochloric acid, with test-solution of chloride of barium.	Almost odorless; acid, strongly styptic taste; acid reaction.	Miscible in all proportions without decomposition.	Miscible in all proportions without decomposition.

Test for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
On slowly mixing 2 volumes of the Solution with 1 volume of concentrated sulphuric acid, in a beaker, the mixture does not separate a solid, white mass on standing (difference from subsulphate).	Nitric Acid.	On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a moderately diluted portion of the Solution, the crystal should not become brown, nor should there be a brownish-black zone developed around it.
10 Gm. of the Solution, when completely precipitated by excess of water of ammonia, yield a precipitate, which, when washed, dried, and ignited, should weigh 1.147 Gm.	Ferrous Salt.	A few drops added to freshly prepared test-solution of ferricyanide of potassium should impart to it a pure greenish-brown color without a trace of blue.

Uses.—This solution is largely used in pharmacy in preparing ferric hydrate through precipitation with ammonia. From this many of the iron salts and solutions are made. It is not used medicinally to any great extent, the solution of the subsulphate of iron being preferred.

Chromium. Cr; 52.4.

Chromium occurs in nature as chrome-iron ore, large deposits of which are found in Southeastern Pennsylvania. This metal is brittle, of a grayish-white color, and very hard, being capable of scratching glass. It forms five compounds with oxygen: 1. Monoxide, or *chromous oxide*, CrO. 2. *Trichromic tetroxide*, Cr_3O_4. 3. Sesquioxide, or *chromic oxide*, Cr_2O_3. 4. Dioxide, CrO_2. 5. *Chromium trioxide*, CrO_3. The latter alone and its salts are of pharmaceutical interest.

Tests for Chromium Salts.

1. Ammonium sulphide precipitates from solutions of chromium salts a greenish precipitate of chromic hydroxide.
2. Sodium or potassium hydrate also produces a precipitate of chromic hydroxide, soluble in excess.
3. Soluble lead salts produce yellow precipitates of lead chromate (chrome yellow).

Officinal Preparations containing Chromium.

Officinal Name.	Preparation.
Acidum Chromicum . .	Made by decomposing potassium bichromate with sulphuric acid.
Potassii Bichromas . . .	Made by removing one-half of the potassium from potassium chromate with sulphuric acid, evaporating and crystallizing (see page 452).

Unofficinal Preparations of Chromium.

Chromii Bromidum, Cr_2Br_6, = 583.6. Bromide of Chromium.	By passing bromine vapor over an ignited mixture of chromic oxide with charcoal and starch paste.
Chromii Dichloridum, $CrCl_2$, = 123.2. Dichloride of Chromium.	By passing dry chlorine gas over a red-hot mixture of charcoal and chromic oxide.
Chromii Fluoridum, Cr_2Fl_6, = 218.8. Fluoride of Chromium.	By treating chromic oxide, dried, but not ignited, with excess of hydrofluoric acid, and heating the dried mass very strongly in a platinum crucible.
Chromii Iodidum, Cr_2I_6, = 864.4. Iodide of Chromium.	By treating silver chromate with hydriodic acid and alcohol.
Chromii Sulphas, $Cr_2(SO_4)_3.5H_2O$, = 482.8. Sulphate of Chromium (Green).	By dissolving chromic oxide in strong sulphuric acid at a temperature between 50° and 60° C.

ACIDUM CHROMICUM. *U.S.* Chromic Acid.

CrO_3; 100.4.

Preparation.—Chromic acid is readily obtained by mixing one hundred measures of a cold saturated solution of potassium bichromate with one hundred and fifty measures of sulphuric acid, and allowing the mixture to cool. The sulphuric acid unites with the potassium, and sets free the chromic anhydride, which is deposited in crystals. The mother-liquor having been poured off, these are transferred to a glass funnel, and the mother-liquor displaced by nitric acid; they are then placed upon a tile to drain, covered with a glass bell-jar. Chromic acid should be preserved in glass-stoppered vials.

$$\underset{\text{Potassium Bichromate.}}{K_2Cr_2O_7} + \underset{\text{Sulphuric Acid.}}{2H_2SO_4} = \underset{\text{Chromic Acid.}}{2CrO_3} + \underset{\text{Potassium Acid Sulphate.}}{2KHSO_4} + \underset{\text{Water.}}{H_2O}.$$

Acidum Chromicum. *U.S.*	Odor and Reaction.	Solubility.	
		Water.	Alcohol.
Small, crimson, needle-shaped or columnar crystals, deliquescent, having a caustic effect upon the skin and other animal tissues.	Odorless; acid reaction.	Very soluble, forming an orange-red solution.	Brought in contact with alcohol, mutual decomposition takes place.

Tests for Identity.	Impurities.	Test for Impurities.
When heated to about 190° C. (374° F.), the acid melts, and at 250° C. (482° F.) it is mostly decomposed with the formation of dark green chromic oxide and the evolution of oxygen. On contact, trituration, or warming with strong alcohol, glycerin, spirits of nitrous ether, or other easily oxidizable substances, it is liable to cause sudden combustion or explosion.	Sulphuric Acid.	If 1 Gm of the acid be dissolved in 100 C.c. of cold water and mixed with 10 C.c. of hydrochloric acid, the further addition of 1 C.c. of test-solution of chloride of barium should cause not more than a white turbidity.

Uses.—Chromic acid, or, more properly, *chromic anhydride*, is a powerful caustic and antiseptic: it parts with its combined oxygen with great facility. It is a very effective caustic in destroying warty growths. Care must be used, in mixing it with glycerin, sugar, or similar deoxidizing bodies, to avoid explosions. It is not used internally.

CHAPTER XLV.

NICKEL, COBALT, AND TIN.

Ni; 58. Co; 58.9. Sn; 117.7.

NEITHER of these metals nor any of their compounds are considered of sufficient medicinal importance to give them a place in the U. S. Pharmacopœia. Their salts are sometimes used medicinally, and two of the metals are important in many respects, particularly in the arts.

Nickel. Ni; 58.

This metal is found in magnetic pyrites in Pennsylvania; also as arsenide or *kupfernickel* in Germany and Sweden, and as a silicate in New Caledonia. Its sp. gr. is 8.9. It is a white, malleable metal, and forms with copper a valuable alloy, known as German silver. This alloy is also used for making coins. Salts of nickel are very largely employed in electro-plating.

Tests for Compounds of Nickel.

1. Ammonium sulphide produces with a solution of a nickel salt a black precipitate (sulphide), insoluble in diluted hydrochloric acid, but soluble in hot nitric acid.
2. Potassium or sodium hydrate produces with nickel salts pale green precipitates of hydroxide insoluble in an excess.
3. Potassium cyanide produces a green precipitate with a solution of a nickel salt, soluble in an excess, but reprecipitated by hydrochloric acid.

Unofficinal Salts of Nickel.

Niccoli Bromidum, $NiBr_2$, = 217.6. Bromide of Nickel.	By dissolving nickel carbonate in hydrobromic acid, concentrating, then crystallizing.
Niccoli Carbonas, $NiCO_3$, = 118. Carbonate of Nickel.	By heating nickel chloride with an alkaline carbonate in sealed tubes and collecting the powder.
Niccoli Chloridum, $NiCl_2$, = 128.8. Chloride of Nickel.	By heating nickel filings to low redness in a stream of chlorine.
Niccoli Cyanidum, $NiCN_2$, = 98. Cyanide of Nickel.	By adding to a solution of potassium cyanide a solution of any nickel salt in slight excess and collecting the precipitate.
Niccoli Sulphas, $NiSO_4.7H_2O$, = 280. Sulphate of Nickel.	By dissolving pure nickel carbonate in diluted sulphuric acid, concentrating the solution, then crystallizing.

Cobalt. Co; 58.9.

This metal is usually found associated with arsenical ores. It is white, tough, and brittle, unalterable in the air, and strongly magnetic. Sp. gr. 8.5. It forms two classes of salts, cobaltous and cobaltic, in this respect resembling iron. The native ore *skutterudite*,

$CoAs_3$, and other cobalt minerals containing arsenic, are often sold in commerce under the name of *flystone*. It is used as a fly-poison by breaking it into small fragments and mixing them with sweetened water. The *chloride* and *sulphocyanate of cobalt* have been used to make *barometer paper*, by dipping ordinary white paper into a solution and drying it: when dry the color is blue, but an increase of moisture in the air changes the color to pink.

Cobalt forms no officinal salts, and none of the unofficinal salts are of pharmaceutical interest.

Tests for Salts of Cobalt.

1. Ammonium sulphide produces in a solution of a cobaltous salt a black precipitate (sulphide), insoluble in diluted hydrochloric acid.
2. Solution of potassa produces with a solution of a cobaltous salt a blue precipitate, changing by heat first to a violet and subsequently to a red color.
3. Potassium cyanide produces a yellowish-brown precipitate, soluble in an excess; the clear solution after being boiled does not afford a precipitate with hydrochloric acid (difference from nickel salts).

Tin. Sn; 117.7.

The sulphide and oxide are the forms in which tin is usually found. Tin is a valuable white metal, of a silvery color, which, when bent, emits a peculiar crackling sound. Its sp. gr. is 7.3. It forms two classes of compounds, called *stannous* and *stannic* salts. These are not used to any extent in medicine or pharmacy, but are of great importance in the arts.

Tests for Compounds of Tin.

1. Potassium or sodium hydrate produces in a solution of a salt of tin a white precipitate (hydroxide), soluble in an excess.
2. Water of ammonia produces a white precipitate (hydroxide) with a solution of a stannous salt, nearly insoluble in an excess. The same reagent with a stannic salt produces a similar white precipitate (hydroxide), slightly soluble in an excess.
3. Ammonium sulphide produces in solutions of stannous salts a brownish-black precipitate, soluble in an excess (if an excess of sulphur be present in the reagent). The yellow sulphide is precipitated from this solution on the addition of an acid. Ammonium sulphide with stannic salts produces a yellow precipitate, soluble in an excess.
4. Mercuric chloride in contact with stannous salts is reduced to mercurous chloride or metallic mercury; no change occurs when it is added to stannic salts.

Unofficinal Salts of Tin.

Stanni Chloridum, $SnCl_2,2H_2O$, = 224.5. Chloride of Tin (tin salt).	By dissolving tin in hot hydrochloric acid.
Stanni Sulphidum, SnS, = 149.7.	By passing hydrosulphuric acid gas into a solution of stannic chloride.
Sodii Stannas, Na_2SnO_3, = 211.7.	By boiling tin ore with solution of caustic soda.
Acidum Stannicum, $SnO_2,2H_2O$, = 185.7.	By precipitating a solution of an alkaline stannate with an acid.
Acidum Metastannicum, $5SnO_2,10H_2O$, = 928.5.	By acting on tin with nitric acid.

CHAPTER XLVI.

LEAD, COPPER, SILVER, AND MERCURY.

Pb; 206.5. Cu; 63.2. Ag; 107.7. Hg; 199.7.

THIS group embraces four well-known metals, which furnish compounds of great value as medicines. They are allied to one another chemically, although they differ greatly in their physical properties.

Lead. Pb; 206.5.

Lead is obtained from the native sulphide, *galena*, by roasting in a reverberatory furnace. It is often associated with silver. It is a heavy, soft, bluish metal, with a specific gravity of 11.45. Lead forms five compounds with oxygen: 1. Suboxide, Pb_2O. 2. Monoxide, PbO. 3. Sesquioxide, Pb_2O_3. 4. Dioxide, PbO_2. 5. Triplumbic tetroxide, Pb_3O_4.

Tests for Compounds of Lead.

1. Hydrosulphuric acid or ammonium sulphide precipitates the insoluble black sulphide from salts of lead.
2. Sulphuric acid or a sulphate causes the precipitation of the white sulphate, insoluble in nitric acid.
3. The alkaline carbonates (sodium, potassium, and ammonium) precipitate lead carbonate, insoluble in an excess.

Poisonous Properties of Lead and its Compounds.

Pure water dissolves appreciable quantities of lead through the formation of a slightly soluble hydroxide or carbonate. If traces of sulphates or chlorides be present in the water, an insoluble coating is formed on the surface of the metal, which protects it from further decomposition. Lead pipes and lead tanks for containing drinking-water should be used with care (see U. S. Dispensatory, 15th ed., page 1127).

Officinal Preparations of Lead.

Officinal Name.	Preparation.
Plumbi Acetas	Made by treating lead oxide with acetic acid, evaporating and crystallizing.
Liquor Plumbi Subacetatis	By boiling solution of lead acetate with lead oxide.
Liquor Plumbi Subacetatis Dilutus	By diluting 3 parts of solution of subacetate of lead with 97 parts of water.
Ceratum Plumbi Subacetatis	By mixing 20 parts of solution of subacetate of lead with 80 parts of camphor cerate.

Officinal Preparations of Lead.—(*Continued.*)

Officinal Name.	Preparation.
Linimentum Plumbi Subacetatis	By mixing 40 parts of solution of subacetate of lead with 60 parts of cotton seed oil.
Plumbi Carbonas	By acting on metallic lead with fumes of acetic acid and decaying matter.
Unguentum Plumbi Carbonatis	By rubbing 10 parts of lead carbonate with 90 parts of benzoinated lard.
Plumbi Iodidum	By double decomposition between lead nitrate and potassium iodide.
Unguentum Plumbi Iodidi	By rubbing 10 parts of lead iodide with 90 parts of benzoinated lard.
Plumbi Nitras	By treating lead oxide with diluted nitric acid, evaporating and crystallizing.
Plumbi Oxidum	By roasting lead ore in reverberatory furnaces.
Unguentum Diachylon	By diluting lead plaster with olive oil and adding a little oil of lavender.
Emplastrum Plumbi	By boiling lead oxide with olive oil and water.

Unofficinal Preparations of Lead.

Plumbi Binoxidum, PbO_2, = 238.5. Binoxide of Lead.	By treating red lead with diluted nitric acid and collecting the insoluble powder.
Plumbi Bromidum, $PbBr_2$, = 366.5. Bromide of Lead.	By making separate solutions of lead acetate and potassium bromide, mixing them, and collecting the precipitate.
Plumbi Chloridum, $PbCl_2$, = 277.3. Chloride of Lead.	By dissolving lead acetate in water and adding hydrochloric acid, then collecting the precipitate.
Plumbi Chloris, $Pb(ClO_2)_2$, = 341.3. Chlorite of Lead.	By making separate solutions of lead nitrate and neutral calcium chlorite, mixing them, and collecting the precipitate.
Plumbi Chromas, $PbCrO_4$, = 322.9. Chromate of Lead.	By making separate solutions of lead nitrate and potassium bichromate, mixing them, and collecting the precipitate.
Plumbi Oxidum Rubrum, Pb_3O_4, = 683.5. Red Oxide of Lead.	By heating massicot to near 450° C. (840° F.); it gradually combines with the oxygen of the air, which converts it into red lead.
Plumbi Saccharas. Saccharate of Lead.	By saturating a solution of saccharic acid in water with freshly precipitated lead carbonate gradually added.
Plumbi Sulphas, $PbSO_4$, = 302.5. Sulphate of Lead.	By dissolving lead nitrate in water and adding sulphuric acid, then collecting the precipitate.
Plumbi Tannas. Tannate of Lead.	By adding a solution of tannin to one of lead acetate and collecting the precipitate.

PLUMBI ACETAS. *U.S.* Acetate of Lead.

$Pb(C_2H_3O_2)_2.3H_2O$; 378.5. [Sugar of Lead.]

Preparation.—This important salt is made by adding lead oxide to acetic acid, and gently heating the mixture until combination takes place.

$$\underset{\text{Lead Oxide.}}{PbO} + \underset{\text{Acetic Acid.}}{2HC_2H_3O_2} = \underset{\text{Lead Acetate.}}{Pb(C_2H_3O_2)_2} + \underset{\text{Water.}}{H_2O}.$$

The commercial salt is unfit for pharmaceutical uses; it is not expected to be pure, and usually contains both carbonate and oxide. The officinal salt is thus described:

Plumbi Acetas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, shining, transparent, prismatic crystals or scales, efflorescent and attracting carbonic acid on exposure to air. The solutions exhibit generally a slight turbidity, which is removed by the addition of a few drops of acetic acid.	Faintly acetous odor; sweetish, astringent, afterwards metallic taste; faintly acid reaction.	Cold. 1.8 parts. Boiling. 0.5 part.	Cold. 8 parts. Boiling. 1 part.

Tests for Identity.	Impurities.	Tests for Impurities.
When heated, the salt melts, then begins to lose water and acetic acid, and at a higher temperature it is decomposed. The aqueous solution yields a black precipitate with hydrosulphuric acid, a white one with diluted sulphuric acid, and a yellow one with test-solution of iodide of potassium. On heating the salt with sulphuric acid, acetous vapors are evolved.	Zinc, Alkalies or Alkaline Earths.	The aqueous solution of the salt, when completely precipitated by hydrosulphuric acid, should yield a filtrate which leaves no residue on evaporation.
	Copper.	On precipitating a 10 per cent. aqueous solution of the salt with diluted sulphuric acid, the filtrate, when supersaturated with ammonia, should not exhibit a blue tint.

Uses.—Acetate of lead is a valuable astringent and sedative: it is used both internally and externally. The dose is from one to three grains. Its solution in water is turbid, due to the formation of a trace of carbonate through the carbonic acid present in the water: this precipitate may be dissolved by the addition of a little acetic acid.

LIQUOR PLUMBI SUBACETATIS. *U. S.* **Solution of Subacetate of Lead.**

An aqueous liquid containing in solution about 25 per cent. of Subacetate of Lead.

	By measure.
Acetate of Lead, 170 parts, or	4 oz. av. 150 gr.
Oxide of Lead, 120 parts, or	3 oz. av. 30 gr.
Distilled Water, a sufficient quantity,	
To make 1000 parts, or	20 fl. oz.

Dissolve the Acetate of Lead in *eight hundred parts* [or 20 fl. oz.] of boiling, Distilled Water, in a glass or porcelain vessel. Then add the Oxide of Lead and boil for half an hour, occasionally adding enough hot, Distilled Water to make up the loss by evaporation. Remove the heat, allow the liquid to cool, and add enough Distilled Water, previously boiled and cooled, to make the product weigh *one thousand parts* [or measure 20 fl. oz.]. Finally, filter the liquid in a well-covered funnel. Solution of Subacetate of Lead should be kept in well-stopped bottles.

The object of this process is to furnish a concentrated solution of a lead compound containing a small proportion of acetic acid. The "subacetate" is not a definite salt, but as found in the officinal solution it is a mixture of oxyacetates, produced by boiling the normal acetate in water in contact with the oxide.

$$\underset{\text{Lead Oxide.}}{3PbO} + \underset{\text{Lead Acetate.}}{3(Pb2C_2H_3O_2)} = \underset{\text{Lead Oxyacetates.}}{Pb_3O(C_2H_3O_2)_4 + Pb_3O_2(C_2H_3O_2)_2}$$

Liquor Plumbi Subacetatis. *U. S.*	Quantitative Test.
A clear, colorless liquid, of a sweetish, astringent taste, and an alkaline reaction. Sp. gr. 1.228. When added to a solution of acacia, it produces a dense white precipitate. In other respects it possesses the reactions of an aqueous solution of acetate of lead (see Plumbi Acetas).	13.7 Gm. of the Solution should require for complete precipitation 25 C.c. of the volumetric solution of oxalic acid.

Uses.—This solution, which is frequently termed *Goulard's Extract*, is sedative and astringent: it is employed externally as an application to inflamed surfaces.

LIQUOR PLUMBI SUBACETATIS DILUTUS. *U.S.* **Diluted Solution of Subacetate of Lead.**

[LEAD-WATER.]

	By measure.
Solution of Subacetate of Lead, 3 parts, or	1 fl. dr.
Distilled Water, 97 parts, or	5 fl. oz.
To make 100 parts, or . . . about	5 fl. oz.

Mix the Solution of Subacetate of Lead with the Distilled Water previously boiled and cooled. Keep the liquid in well-stopped bottles.

This solution is opalescent, through the formation of a trace of carbonate, if the distilled water used has not been recently boiled and cooled, the object of which is to deprive the water of carbonic acid gas. The addition of a few drops of acetic acid clears the solution by dissolving the precipitate; but, as many serious errors have occurred through the internal use by patients of *lead*-water in mistake for *lime*-water, it is a good practice to dispense lead-water in a slightly opalescent condition and lime-water always as a transparent liquid, and, as an additional safeguard, to use blue poison-bottles for the lead-water.

Uses.—Lead-water is used as a soothing application to inflamed surfaces.

CERATUM PLUMBI SUBACETATIS. *U.S.* **Cerate of Subacetate of Lead.**

[GOULARD'S CERATE.]

This cerate is made by mixing twenty parts of solution of subacetate of lead with eighty parts of camphor cerate. It possesses the sedative and astringent properties of the lead solution. It may be prevented from assuming a yellow color by the addition of a trace of acetic acid (see Part V.).

LINIMENTUM PLUMBI SUBACETATIS. *U.S.* **Liniment of Subacetate of Lead.**

This liniment is made by mixing forty parts of solution of subacetate of lead with sixty parts of cotton seed oil (see page 287). It is used principally as a sedative application to burns.

PLUMBI CARBONAS. *U.S.* **Carbonate of Lead.**

$(PbCO_3)_2.Pb(HO)_2$; 778.5. [WHITE LEAD.]

Preparation.—This compound of lead may be made by mixing solutions of lead nitrate and sodium carbonate. It is manufactured on an immense scale for use in the arts by exposing lead to the action of the air, acetic acid, and carbon dioxide.

Plumbi Carbonas. *U. S.*	Odor and Taste.	Solubility.	
		Water.	Alcohol.
A heavy, white, opaque powder or pulverulent mass, permanent in the air. When strongly heated, the salt turns yellow, without charring, and, if heated in contact with charcoal, is reduced to metallic lead.	Odorless; tasteless.	Insoluble.	Insoluble.

Tests for Identity.	Impurities.	Test for Impurities.
The salt dissolves in diluted nitric acid with effervescence, and without leaving more than a trifling residue. This solution yields a black precipitate with hydrosulphuric acid, a white one with diluted sulphuric acid, and a yellow one with test-solution of iodide of potassium.	Zinc, Alkalies or Alkaline Earths.	On completely precipitating the solution of the salt with hydrosulphuric acid, the filtrate should not leave more than a trifling residue on evaporation.

Uses.—Carbonate of lead is employed externally in the form of an ointment, and is popularly used as a cosmetic. Its use is dangerous, however, owing to the risk from absorption. It is used in solution of gutta-percha to clarify it, by aiding in carrying down mechanical impurities by its weight. When ground in oil this salt of lead is largely used as a paint; it is also employed occasionally in this form as an application to inflamed surfaces.

It is rarely administered internally.

UNGUENTUM PLUMBI CARBONATIS. *U.S.* Ointment of Carbonate of Lead.

This ointment is made by rubbing ten parts of carbonate of lead with ninety parts of benzoinated lard. It is used as a soothing application to inflamed surfaces.

PLUMBI IODIDUM. *U.S.* Iodide of Lead.

PbI_2; 459.7.

Preparation.—This iodide may be made by the British process:

Take of Nitrate of Lead, Iodide of Potassium, each, 4 oz. av.; Distilled Water a sufficiency. Dissolve the Nitrate of Lead, by the aid of heat, in a pint and a half, and the Iodide of Potassium in half a pint of the Water, and mix the solutions. Collect the precipitate on a filter, wash it with Distilled Water, and dry it at a gentle heat.

This is an instance of double decomposition, lead iodide and potassium nitrate being formed. The nitrate is preferred to the acetate, because lead iodide is more soluble in solution of potassium acetate than in that of potassium nitrate.

$$\underset{\text{Potassium Iodide.}}{2KI} + \underset{\text{Lead Nitrate.}}{Pb2NO_3} = \underset{\text{Lead Iodide.}}{PbI_2} + \underset{\text{Potassium Nitrate.}}{2KNO_3}.$$

Plumbi Iodidum. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A heavy, bright citron-yellow powder, permanent in the air. When strongly heated, the salt fuses, and at a higher temperature it is decomposed, emitting violet vapors of iodine, and leaving a citron-yellow residue.	Odorless; tasteless; neutral reaction.	Cold. 2000 parts. Boiling. 200 parts.	Very slightly soluble.	Readily dissolved by aqueous solutions of the acetates of alkalies and by solution of chloride of ammonium.

Tests for Identity.	Impurities.	Test for Impurities.
On triturating 1 part of the salt with 2 parts of chloride of ammonium in a porcelain mortar, and adding 2 parts of water, a colorless liquid should result. This liquid, diluted with water, affords a white precipitate with diluted sulphuric acid, and a black one with hydrosulphuric acid.	Zinc, Alkalies or Alkaline Earths.	If all the lead has been precipitated from a solution of the salt by hydrosulphuric acid, the filtrate should leave no residue on evaporation and gentle ignition.

Uses.—Lead iodide is used principally to form an officinal ointment. It may be given internally in doses of one to three grains.

UNGUENTUM PLUMBI IODIDI. *U. S.* Ointment of Iodide of Lead.

This ointment is made by rubbing ten parts of lead iodide with ninety parts of benzoinated lard. It is used as an application to tumors and indolent swellings.

PLUMBI NITRAS. *U. S.* Nitrate of Lead.

$Pb(NO_3)_2$; 330.5.

Preparation.—This salt may be easily made by adding lead oxide to equal parts of nitric acid and water, heating the mixture until the solution is effected, and, after filtering, evaporating the solution of lead nitrate and crystallizing.

Plumbi Nitras. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, transparent or white, nearly opaque, octahedral crystals, permanent in the air. When strongly heated, the salt decrepitates, emits nitrous vapors, and finally leaves a residue of oxide of lead.	Odorless; sweetish, astringent, afterwards metallic taste; acid reaction.	Cold. 2 parts. Boiling. 0.8 part.	Almost insoluble.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution of the salt yields a black precipitate with hydrosulphuric acid, a white one with diluted sulphuric acid, and a yellow one with test-solution of iodide of potassium.	Zinc, Alkalies or Alkaline Earths.	When the salt is completely precipitated with hydrosulphuric acid, the solution should yield a filtrate which leaves no residue on evaporation.
	Copper.	On precipitating a 10 per cent. solution of the salt with diluted sulphuric acid, the filtrate, when supersaturated with ammonia, should not exhibit a blue tint.

Uses.—Nitrate of lead is used in solution principally as an external application to excoriated surfaces.

PLUMBI OXIDUM. *U.S.* Oxide of Lead.

PbO; 222.5. [LITHARGE.]

Preparation.—Litharge is lead oxide which has been rendered semi-crystalline by incomplete fusion. Almost all the litharge of commerce is obtained as a secondary product in the process for extracting silver from argentiferous galenas. After extracting the lead from the ore, the alloy is calcined in the open air; whereby the lead becomes oxidized, and by fusion passes into the state of litharge, while the silver remains unchanged.

Red lead is a higher oxide, Pb_3O_4; 683.5, and is made by sprinkling hot litharge with water, powdering and drying it, and then heating it out of contact with air. Litharge is officinally described as follows:

Plumbi Oxidum. *U.S.*	Odor and Taste.	Solubility.	
		Water.	Alcohol.
A heavy, yellowish or reddish-yellow powder, or minute scales, permanent in the air. When heated in contact with charcoal, it is reduced to metallic lead.	Odorless; tasteless.	Insoluble.	Insoluble.

Tests for Identity.	Impurities.	Tests for Impurities.
The diluted and filtered solution of the salt yields a black precipitate with hydrosulphuric acid, a white one with diluted sulphuric acid, and a yellow one with test-solution of iodide of potassium.	Carbonate.	Oxide of Lead should be soluble in diluted nitric acid, without leaving more than a trifling residue, and with but little effervescence.
	Zinc, Alkalies or Alkaline Earths.	If the lead be completely precipitated with hydrosulphuric acid, the resulting filtrate should not leave more than a trace of residue on evaporation.

EMPLASTRUM PLUMBI. *U.S.* Lead Plaster.

This compound of lead is made by boiling lead oxide with olive oil and water, whereby the lead enters into combination with the fatty acids of the oil: it is an oleo-palmitate of lead. (See Glycerinum.) It is used as the basis of many plasters.

UNGUENTUM DIACHYLON. *U.S.* Diachylon Ointment.

This ointment is simply lead plaster diluted with olive oil to the consistence of an ointment, and slightly perfumed with oil of lavender. (See Unguenta.) It is used externally in several skin diseases.

Copper. Cu; 63.2.

Copper is found naturally in its metallic condition, as a sulphide or oxide, and as a sulphate, carbonate, phosphate, or arseniate. It is a brilliant metal, of a red color, having a sp. gr. of 8.92 to 8.95. It

forms two oxides: 1. Red cuprous oxide, Cu_2O, and, 2. Black cupric oxide, CuO.

Tests for Compounds of Copper.

1. Hydrosulphuric acid or ammonium sulphide produces a black precipitate of cupric sulphide.
2. Water of ammonia produces in concentrated solutions of copper salts a pale blue precipitate of cupric hydroxide, in dilute solutions a deep blue coloration.
3. Potassium ferrocyanide produces a reddish-brown precipitate of cupric ferrocyanide.
4. A bright surface of metallic iron or zinc immersed in an acidulated solution of a copper salt is coated with metallic copper.
5. Copper salts color the flame of an alcohol lamp or Bunsen burner green.

Officinal Preparations of Copper.

Officinal Name.	Preparation.
Cupri Acetas . . .	By treating copper with acetic acid and purifying the product by crystallization.
Cupri Sulphas . .	By treating copper with diluted sulphuric acid, evaporating the solution, and crystallizing.

Unofficinal Preparations of Copper.

Cupri Arsenias, $Cu_3As_2O_8$, = 392.1. Arseniate of Copper.	By adding a solution of copper sulphate to a solution of disodic arseniate, collecting and drying the precipitate.
Cupri Bromidum, $CuBr_2$, = 223.2. Bromide of Copper.	By evaporating a solution of cupric oxide in aqueous hydrobromic acid, and fusing the residue at a gentle heat.
Cupri Citras. Citrate of Copper.	By heating a solution of cupric acetate with citric acid and setting aside to crystallize.
Cupri Nitras, $Cu(NO_3)_2$, = 187.2. Nitrate of Copper.	By dissolving metallic copper in nitric acid and concentrating the solution, then crystallizing.
Cupri Oxidum, CuO, = 79.2. Oxide of Copper.	By continued ignition of copper in contact with air.
Cupri Subacetas, = $Cu(HO)_2$. $Cu(C_2H_3O_2)_2$, = 278.4. Verdigris.	Made by acting on sheets of copper with acetic acid.
Cupri Tartras. Tartrate of Copper.	By adding a solution of neutral potassium tartrate to a solution of cupric sulphate and collecting the precipitate.

CUPRI ACETAS. *U. S.* Acetate of Copper.

$Cu(C_2H_3O_2)_2.H_2O$; 199.2.

Preparation.—Cupric acetate may be prepared by dissolving verdigris in acetic acid, or by precipitating a concentrated solution of lead acetate with copper sulphate. The filtered solution is evaporated and crystallized. It is the normal cupric acetate, as distinguished from the other basic salts.

Cupri Acetas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Deep green, prismatic crystals, yielding a bright green powder, efflorescent on exposure to air. When heated above 100° C. (212° F.), the salt loses its water of crystallization, and at a temperature above 200° C. (392° F.) it is gradually decomposed.	Odorless; nauseating, metallic taste; acid reaction.	Cold. 15 parts. Boiling. 5 parts.	Cold. 135 parts. Boiling. 14 parts.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution of the salt has a bluish-green color, which is rendered deep blue by an excess of ammonia. On heating the salt with sulphuric acid, acetous vapors are evolved.	Alkalies, Alkaline Earths and Iron.	If the aqueous solution of the salt be treated with hydrosulphuric acid until all the copper is precipitated, the filtrate should leave no residue on evaporation.
	Lead, Zinc.	If the aqueous solution be heated to boiling with solution of soda in excess, it will yield a filtrate which should not be clouded by hydrosulphuric acid.

Uses.—Acetate of copper, or *verdigris*, is used for the same purposes as the sulphate of copper. It enters into a popular remedy for corns: it is supposed to soften and remove them.

CUPRI SULPHAS. *U. S.* Sulphate of Copper.

$CuSO_4.5H_2O$; 249.2.

Preparation.—This salt is economically made by acting on scrap copper with diluted sulphuric acid, heating, evaporating the solution, and crystallizing.

Cupri Sulphas. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Large, translucent, deep blue, triclinic crystals, efflorescent. When heated to 100° C. (212° F.), the salt gradually loses 28.9 per cent. of its weight. At a temperature of about 230° C. (446° F.) it becomes anhydrous, and at a red heat it is decomposed, evolving sulphurous vapors and finally leaving black cupric oxide.	Odorless; nauseous, metallic taste; acid reaction.	Cold. 2.6 parts. Boiling. 0.5 part.	Insoluble.

Tests for Identity.	Impurities.	Test for Impurities.
The aqueous solution of the salt has a pale blue color, which is rendered deep blue by an excess of ammonia. With test-solution of chloride of barium it yields a white precipitate insoluble in hydrochloric acid.	Foreign Metals, Alkalies and Alkaline Earths.	If a little hydrochloric and some diluted sulphuric acid be added to a 5 per cent. aqueous solution of the salt, and this be treated with hydrosulphuric acid until the copper is completely precipitated, the filtrate should leave no residue on evaporation.

Uses.—Sulphate of copper, called commercially *blue vitriol*, is used internally as an emetic in doses of five grains; as an astringent or tonic, from one-quarter to one-half grain is given. It is used as an injection in gonorrhœa and other diseases, and also as a stimulant wash, and in substance as an escharotic.

Silver. Ag; 107.7.

Silver is found in the metallic state, but usually as a sulphide, and associated with lead sulphide, or *galena*.

Silver is a brilliant white metal, very malleable and ductile, having a sp. gr. of 10.4 to 10.5. It forms but one oxide, Ag_2O.

Tests for Silver Salts.

1. Hydrochloric acid or any soluble chloride produces with a soluble salt of silver a characteristic, curdy, white precipitate of silver chloride, which is insoluble in hot nitric acid, but soluble in water of ammonia.
2. Hydrosulphuric acid or ammonium sulphide produces a black precipitate of silver sulphide.
3. Caustic alkalies produce a brown precipitate of silver oxide.

Officinal Preparations of Silver.

Officinal Name.	Preparation.
Argenti Cyanidum . .	By passing hydrocyanic acid gas into solution of silver nitrate.
Argenti Iodidum . . .	By double decomposition between potassium iodide and silver nitrate.
Argenti Nitras	By treating metallic silver with nitric acid, evaporating the solution, and crystallizing.
Argenti Nitras Dilutus .	By fusing equal parts of silver nitrate and potassium nitrate.
Argenti Nitras Fusus .	By fusing and moulding silver nitrate.
Argenti Oxidum . . .	By precipitating solution of silver nitrate with solution of potassa.

Unofficinal Preparations of Silver.

Argenti Acetas, $AgC_2H_3O_2$, = 166.7. Acetate of Silver.	By adding a solution of silver nitrate to a solution of sodium acetate, then collecting and drying the precipitate.
Argenti Bromidum, AgBr, = 187.7. Bromide of Silver.	By adding to a solution of silver nitrate a solution of potassium bromide, collecting and drying the precipitate.
Argenti Chloridum, AgCl, = 143.1. Chloride of Silver.	By adding to a solution of silver nitrate hydrochloric acid as long as a precipitate is produced, then collecting and drying the precipitate.
Argenti Chromas, Ag_2CrO_4, = 331.8. Chromate of Silver.	By adding a solution of neutral potassium chromate to a solution of silver nitrate, collecting and drying the precipitate.
Argenti Lactas, $AgC_3H_5O_3.H_2O$, = 214.7. Lactate of Silver.	By boiling silver carbonate with lactic acid, collecting and drying the precipitate.
Argenti Oxalas, $Ag_2C_2O_4$, = 303.4. Oxalate of Silver.	By adding a solution of oxalic acid to a solution of silver nitrate, collecting and drying the precipitate.
Argenti Phosphas, Ag_3PO_4, = 418.1. Phosphate of Silver.	By adding a solution of silver nitrate to a solution of sodium phosphate, collecting and drying the precipitate.
Argenti Sulphas, Ag_2SO_4, = 311.4. Sulphate of Silver.	By adding a solution of silver nitrate to a solution of sodium sulphate, collecting and drying the precipitate.

ARGENTI CYANIDUM. *U. S.* Cyanide of Silver.

AgCN; 133.7.

Preparation.—Silver cyanide is easily prepared by passing hydrocyanic acid gas into a solution of silver nitrate, or by mixing solutions of potassium cyanide and silver nitrate.

$$\underset{\text{Silver Nitrate.}}{AgNO_3} + \underset{\text{Potassium Cyanide.}}{KCN} = \underset{\text{Silver Cyanide.}}{AgCN} + \underset{\text{Potassium Nitrate.}}{KNO_3}.$$

Argenti Cyanidum. *U. S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A white powder, permanent in dry air, but gradually turning brown by exposure to light.	Odorless; tasteless.	Insoluble.	Insoluble.	Insoluble in cold, but soluble in boiling nitric acid, with evolution of hydrocyanic acid; soluble in water of ammonia and in solution of hyposulphite of sodium.

Test for Identity.

When heated, the salt fuses, gives off cyanogen gas, and, on ignition, metallic silver is left.

Uses.—This salt was made officinal to use in the extemporaneous preparation of hydrocyanic acid. (See Acidum Hydrocyanicum Dilutum.)

ARGENTI IODIDUM. *U. S.* Iodide of Silver.

AgI; 284.3.

Preparation.—This iodide may be made by double decomposition between potassium iodide and silver nitrate.

$$\underset{\text{Potassium Iodide.}}{KI} + \underset{\text{Silver Nitrate.}}{AgNO_3} = \underset{\text{Silver Iodide.}}{AgI} + \underset{\text{Potassium Nitrate.}}{KNO_3}.$$

Argenti Iodidum. *U. S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A heavy, amorphous, light yellowish powder, unaltered by light if pure, but generally becoming somewhat greenish-yellow. When heated to about 400° C. (752° F.), it melts to a dark red liquid, which, on cooling, congeals to a soft, yellow, slightly translucent mass.	Odorless; tasteless.	Insoluble.	Insoluble.	Insoluble in diluted acids or in solution of carbonate of ammonium; soluble in about 2500 parts of stronger water of ammonia.

Tests for Identity.	Impurities.	Test for Impurities.
When mixed with water of ammonia, it turns white, but regains its yellowish color by washing with water. It is dissolved by an aqueous solution of cyanide of potassium, and the resulting solution yields a black precipitate with hydrosulphuric acid or sulphide of ammonium. If a small quantity of chlorine water be agitated with an excess of the salt, the filtrate acquires a dark blue color on the addition of gelatinized starch.	Chloride.	If the salt be boiled with test-solution of carbonate of ammonium previously diluted with an equal volume of water, the resulting filtrate, on being supersaturated with nitric acid, should not be rendered more than faintly opalescent.

Uses.—Silver iodide has been used in syphilis, in doses of one-half grain to two grains.

ARGENTI NITRAS. *U.S.* Nitrate of Silver.

$AgNO_3$; 169.7.

Preparation.—This valuable salt may be made by the former officinal process:

Take of Silver, in small pieces, 2 oz. troy; Nitric Acid 2½ oz. troy; Distilled Water a sufficient quantity. Mix the Acid with a fluidounce of Distilled Water in a porcelain capsule, add the Silver to the mixture, cover it with an inverted glass funnel, resting within the edge of the capsule, and apply a gentle heat until the metal is dissolved, and red vapors cease to be produced; then remove the funnel, and, increasing the heat, evaporate the solution to dryness. Melt the dry mass, and continue the heat, stirring constantly with a glass rod, until free nitric acid is entirely dissipated. Dissolve the melted salt, when cold, in six fluidounces of Distilled Water, allow the insoluble matter to subside, and decant the clear solution. Mix the residue with a fluidounce of Distilled Water, filter through paper, and, having added the filtrate to the decanted solution, evaporate the liquid until a pellicle begins to form, and set it aside in a warm place to crystallize. Lastly, drain the crystals in a glass funnel until dry, and preserve them in a well-stopped bottle. By evaporating the mother-water, more crystals may be obtained.

The silver employed is usually coin, and this always contains copper: hence copper nitrate is present, which is known by the bluish color of the solution. By evaporating the solution and fusing the residue the copper salt is decomposed and the insoluble copper oxide produced; by solution and filtration this is separated, and the purified solution of silver nitrate is evaporated and crystallized.

$$\underset{\text{Silver.}}{Ag_3} + \underset{\text{Nitric Acid.}}{4HNO_3} = \underset{\text{Silver Nitrate.}}{3AgNO_3} + \underset{\text{Nitrogen Monoxide.}}{NO} + \underset{\text{Water.}}{2H_2O}.$$

Argenti Nitras. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, transparent, tabular, rhombic crystals, becoming gray or grayish-black on exposure to light in presence of organic matter.	Odorless; bitter, caustic, and strongly metallic taste; neutral reaction.	Cold. 0.8 part. Boiling. 0.1 part.	Cold. 26 parts. Boiling. 5 parts.

Tests for Identity and Quantitative Test.	Impurities.	Test for Impurities.
When heated to about 200° C. (392° F.), the salt fuses to a faintly yellow liquid, which, on cooling, congeals to a purely white, crystalline mass. At a higher temperature the salt is gradually decomposed, with evolution of nitrous vapors. An aqueous solution of the salt yields, with hydrochloric acid, a white precipitate soluble in ammonia. 1 Gm. of Nitrate of Silver, when completely precipitated by hydrochloric acid, should yield 0.84 Gm. of dry chloride of silver.	Foreign Metallic Impurities.	If all the silver be precipitated with hydrochloric acid, and the filtrate be evaporated to dryness, no fixed residue should be left.

Uses.—Silver nitrate is used externally as a caustic and escharotic; internally, it is given in gastritis and diarrhœa, in doses of one-fourth to one-half grain.

ARGENTI NITRAS DILUTUS. *U. S.* **Diluted Nitrate of Silver.**

Nitrate of Silver, 50 parts, or	1 oz. av.
Nitrate of Potassium, 50 parts, or	1 oz. av.
To make 100 parts, or	2 oz. av.

Melt the salts together in a porcelain crucible, at as low a temperature as possible, stirring the melted mass well until it flows smoothly. Then cast it in suitable moulds. Keep the product in dark amber-colored vials, protected from light.

Uses.—The object of this preparation is to provide a fused nitrate of silver, which may often be useful where the undiluted caustic might prove too severe in its action.

Argenti Nitras Dilutus. *U. S.*	Quantitative Test.
A white, hard solid, generally in form of pencils or cones of a finely granular fracture, becoming gray or grayish-black on exposure to light in presence of organic matter. Odorless, having a caustic, metallic taste and a neutral reaction. Each of its constituents retains the solubility in water and in alcohol mentioned respectively under Argenti Nitras and Potassii Nitras.	An aqueous solution of 2 Gm. of Diluted Nitrate of Silver, acidulated with nitric acid, when completely precipitated by hydrochloric acid, should yield not less than 0.84 Gm. of dry chloride of silver. The filtrate, separated from the precipitate, when evaporated to dryness, leaves a residue which is completely soluble in water, and which yields a white, crystalline precipitate with a concentrated solution of bitartrate of sodium.

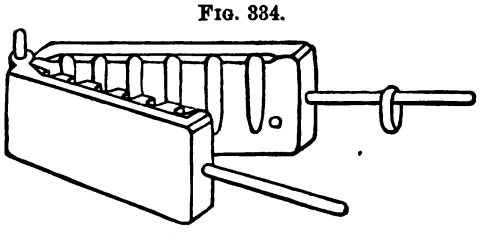
Uses.—This preparation is used only externally. It is similar in its action to the moulded nitrate, but less energetic.

ARGENTI NITRAS FUSUS. *U. S.* **Moulded Nitrate of Silver.**

Nitrate of Silver, 100 parts, or	1 oz. av.
Hydrochloric Acid, 4 parts, or	16 minims.

Melt the Nitrate of Silver in a porcelain capsule, at as low a temperature as possible; then add to it, gradually, the Hydrochloric Acid, stir well, and, when nitrous vapors cease to be evolved, pour the melted mass in suitable moulds. Keep the product in dark amber-colored vials, protected from light.

FIG. 334.



Caustic point mould.

When pure fused silver nitrate is cooled, the mass is very brittle, but the addition of hydrochloric acid produces sufficient silver chloride to toughen it, so that the cast cones or sticks will not break so easily. In order to keep the sticks from becoming discolored during the casting process, it is

advisable to add a diluted nitric acid (1 in 5) occasionally to the melted nitrate, and carefully prevent the mass from becoming overheated. Fig. 334 illustrates the silver moulds used in moulding the cones.

Argenti Nitras Fusus. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A white, hard solid, generally in form of pencils or cones of a fibrous fracture, becoming gray or grayish-black on exposure to light in presence of organic matter.	Odorless; bitter, caustic, and strongly metallic taste; neutral reaction.	Cold. Soluble, with the exception of about 5 per cent. of chloride of silver, in 0.6 part. Boiling. Soluble, with the exception of about 5 per cent. of chloride of silver, in 0.5 part.	Cold. Soluble, with the exception of about 5 per cent. of chloride of silver, in 25 parts. Boiling. Soluble, with the exception of about 5 per cent. of chloride of silver, in 5 parts.	Insoluble in ether. Whatever is left undissolved by water is completely soluble in water of ammonia.

Quantitative Test.

A filtered aqueous solution of 2 Gm. of the salt, acidulated with nitric acid, when completely precipitated by hydrochloric acid, should yield 1.6 Gm. of dry chloride of silver.

Uses.—Moulded silver nitrate is used as an escharotic: a good caustic-holder may be made from a glass stirring-rod of the same diameter as the cone by joining it to the cone with a short length of rubber tubing. The cone may be protected from the action of the air by slipping over it another short length of rubber tubing, having a very short piece of glass rod in the other end as a stopper.

Death has resulted more than once through the careless use of silver nitrate in cauterizing the throat, the cone having slipped out of the holder and then been swallowed by the patient.

ARGENTI OXIDUM. *U. S.* Oxide of Silver.

Ag_2O; 231.4.

Preparation.—This salt may be made by a former officinal process: Take of Nitrate of Silver 4 oz. troy; Distilled Water half a pint; Solution of Potassa 1½ pints, or a sufficient quantity. Dissolve the Nitrate of Silver in the Water, and to the solution add Solution of Potassa so long as it produces a precipitate. Wash this repeatedly with water until the washings are nearly tasteless. Lastly, dry the precipitate and keep it in a well-stopped bottle, protected from the light.

$$\underset{\text{Silver Nitrate.}}{2AgNO_3} + \underset{\text{Potassium Hydrate.}}{2KHO} = \underset{\text{Silver Oxide.}}{Ag_2O} + \underset{\text{Potassium Nitrate.}}{2KNO_3} + \underset{\text{Water.}}{H_2O}.$$

Argenti Oxidum. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A heavy, dark brownish-black powder, liable to reduction by exposure to light. When heated, it loses oxygen, and metallic silver is left behind.	Odorless; metallic taste; imparting an alkaline reaction to water.	Very slightly soluble.	Insoluble.

Quantitative Test.	Impurities.	Test for Impurities.
1 Gm. of the Oxide, when treated with an excess of hydrochloric acid, should yield 1.236 Gm. of chloride of silver.	Carbonate.	On adding the Oxide of Silver to hydrochloric acid, no effervescence should take place.

Uses.—Silver oxide is used as a substitute for the nitrate, being much less caustic than the latter, and better suited for internal use, owing to the facility with which it parts with its oxygen. Oxide of silver should not be triturated with readily oxidizable or combustible substances, and should not be brought in contact with ammonia.

Gelatin capsules are well fitted for dispensing this compound. With most excipients decomposition ensues, and the pills have been known to explode with some violence.

Mercury. Hg; 199.7.

Mercury, or quicksilver, is found most abundantly as sulphide, or *cinnabar:* the principal mines are in Spain and California. It is a brilliant silver-white metal, liquid above —40° C. (—40° F.), and having the sp. gr. 13.5. Mercury forms two series of compounds,—*mercurous*, containing the group (Hg_2), and *mercuric*, containing the single atom Hg. It is used more largely in medicine in the metallic state than any other element.

Tests for Compounds of Mercury.

1. Ammonium sulphide or hydrosulphuric acid, in excess, produces a black precipitate (sulphide) in solutions of salts of mercury.
2. Potassium iodide produces with mercurous salts a green precipitate of mercurous iodide, or with mercuric salts a red precipitate of mercuric iodide, soluble in excess.
3. With hydrochloric acid or soluble chlorides a white precipitate of mercurous chloride is produced with mercurous salts, whilst with mercuric salts no precipitation occurs.
4. A plate of copper or a solution of stannous chloride, in excess, precipitates the metal from its soluble combinations.

Officinal Preparations of Mercury.

Officinal Name.	Preparation.
Preparations of the Metal.	
Hydrargyrum cum Creta	By extinguishing 38 parts of mercury with 12 parts of sugar of milk and 50 parts of prepared chalk.
Emplastrum Hydrargyri	By extinguishing 30 parts of mercury with 10 parts each of melted resin and olive oil, and incorporating with 50 parts of melted lead plaster.

Officinal Preparations of Mercury.—(*Continued.*)

Officinal Name.	Preparation.
Preparations of the Metal.	
Emplastrum Ammoniaci cum Hydrargyro	By extinguishing 18 per cent. of mercury with ammoniac, olive oil, sublimed sulphur, diluted acetic acid, and lead plaster.
Massa Hydrargyri	By extinguishing 33 per cent. of mercury with honey of rose and glycerin, and then adding powdered glycyrrhiza and powdered althæa.
Unguentum Hydrargyri	By extinguishing 450 parts of mercury with 40 parts of compound tincture of benzoin and 100 parts of mercurial ointment, then adding 225 parts each of melted lard and suet.
Salts of Mercury and their Preparations.	
Hydrargyrum Ammoniatum	By precipitating solution of mercuric chloride with water of ammonia.
Unguentum Hydrargyri Ammoniati.	By incorporating 10 parts of ammoniated mercury with 90 parts of benzoinated lard.
Hydrargyri Chloridum Corrosivum	By subliming mercuric sulphate with sodium chloride.
Hydrargyri Chloridum Mite	By subliming mercuric sulphate and mercury with sodium chloride.
Hydrargyri Cyanidum	By passing hydrocyanic acid into a vessel containing mercuric oxide with water.
Hydrargyri Iodidum Rubrum	By double decomposition between mercuric chloride and potassium iodide.
Hydrargyri Iodidum Viride	By rubbing together mercury and iodine, and washing with alcohol.
Hydrargyri Oxidum Flavum	By precipitating solution of mercuric chloride with potassium hydrate.
Unguentum Hydrargyri Oxidi Flavi.	By incorporating 10 parts of yellow mercuric oxide with 90 parts of ointment.
Oleatum Hydrargyri	By dissolving 10 parts of yellow mercuric oxide in 90 parts of oleic acid.
Hydrargyri Oxidum Rubrum	By decomposing mercuric nitrate by heat.
Unguentum Hydrargyri Oxidi Rubri.	By incorporating 10 parts of red mercuric oxide with 90 parts of ointment.
Hydrargyri Subsulphas Flavus	By adding mercuric sulphate to boiling water.
Hydrargyri Sulphidum Rubrum	By fusing and subliming mercury and sulphur.
Liquor Hydrargyri Nitratis	By dissolving 40 parts of red mercuric oxide in 45 parts of nitric acid and 15 parts of water.
Unguentum Hydrargyri Nitratis	By treating lard oil with nitric acid, and then incorporating solution of mercuric nitrate.

Unofficinal Preparations of Mercury.

Hydrargyri Acetas. Acetate of Mercury.	By dissolving mercuric oxide in acetic acid, filtering, and concentrating to crystallize.
Hydrargyri Arsenias. Arseniate of Mercury.	By adding a solution of arsenic acid to a solution of mercuric nitrate, and collecting the precipitate.
Hydrargyri Bromidum, $HgBr_2$, = 359.7. Bromide of Mercury.	By dissolving mercuric oxide in hot aqueous hydrobromic acid, filtering and concentrating, then crystallizing.
Hydrargyri Carbonas, Hg_2CO_3, = 459.4. Carbonate of Mercury.	By precipitating a solution of mercurous nitrate with acid potassium carbonate, and collecting the precipitate.
Hydrargyri Chloras, $Hg(ClO_3)_2 + H_2O$, = 384.5. Chlorate of Mercury.	By dissolving mercuric oxide in warm chloric acid, filtering and concentrating, then crystallizing.
Hydrargyri Chromas, $HgCrO_4$, = 316.1. Chromate of Mercury.	By boiling equal parts of chromic acid and yellow mercuric oxide in water and collecting the red crystals.
Hydrargyri Lactas $(Hg_2)_2(C_3H_5O_3)_2$. $2H_2O$, = 1012.8. Lactate of Mercury.	By mixing boiling solutions of sodium lactate and mercurous nitrate, and collecting the precipitate.

Unofficinal Preparations of Mercury.—(*Continued.*)

Hydrargyri Nitras, $Hg_3(NO_3)_2.2H_2O$, = 559.4. Nitrate of Mercury.	By mixing 4 p. mercury, 3 p. nitric acid, 1 p. water; after twenty-four hours collecting the crystals.
Hydrargyri Sulphas, $HgSO_4$, = 295.7. Sulphate of Mercury.	By heating 10 oz. mercury with 6 fl. oz. sulphuric acid, in a porcelain vessel, and stirring constantly until a white salt is obtained.

HYDRARGYRUM. *U.S.* Mercury.

Hg; 199.7. [QUICKSILVER.]

Mercury for pharmaceutical uses should be pure. To separate mechanical impurities, moisture, or small quantities of oxide, mercury may be filtered by collecting it in a sound piece of chamois leather and gathering the corners together, forcibly squeezing the particles through the pores of the leather. But distillation is preferable in most cases to purify the metal effectually, which may be accomplished by a process formerly officinal in the British Pharmacopœia, as follows:

Take of Mercury of Commerce 3 pounds [avoirdupois]; Hydrochloric Acid 3 fluidrachms; Distilled Water a sufficiency. Place the Commercial Mercury in a glass retort or iron bottle, and, applying heat, cause two pounds and a half of the metal to distil over into a flask employed as a receiver. Boil on this for five minutes the Hydrochloric Acid diluted with 9 fluidrachms of Distilled Water, and having, by repeated affusions of Distilled Water and decantations, removed every trace of acid, let the mercury be transferred to a porcelain capsule, and dried first by filtering paper, and finally on a water-bath.

Hydrargyrum. *U.S.*	Impurities.	Tests for Impurities.
A shining, silver-white metal, liquid at temperatures above —40° C. (—40° F.), odorless, and tasteless, and insoluble in ordinary solvents, but soluble in nitric acid without residue. Sp. gr. 13.5. At the common temperature it volatilizes very slowly, more rapidly as the temperature increases, and at 350° C. (662° F.) it boils, being finally volatilized without residue.	Tin and other Metals.	When globules of Mercury are dropped upon white paper, they should roll about freely, retaining their globular form, and leaving no streaks or traces.
	Moisture.	Mercury should be perfectly dry.
	Organic Impurities.	Mercury should present a bright surface.
	More than slight traces of Foreign Metals.	On boiling 5 Gm. of distilled water with 5 Gm. of Mercury, and 4.5 Gm. of hyposulphite of sodium, in a test-tube, for about one minute, the Mercury should not lose its lustre, and should not acquire more than a slightly yellowish shade.

Uses.—When mercury is administered in a finely-divided condition, as in blue mass, or in mercury with chalk, it exerts a peculiar action on the liver, which is termed alterative. This action is possessed by some of its salts.

MASSA HYDRARGYRI. *U.S.* Mass of Mercury.

[PILULÆ HYDRARGYRI, Pharm. 1870. BLUE MASS. BLUE PILL.]

Mercury, 33 parts, or	5 oz. av. 122 gr.
Glycyrrhiza, in No. 60 powder, 5 parts, or	350 gr.
Althæa, in No. 60 powder, 25 parts, or	4 oz. av.
Glycerin, 3 parts, or	3 fl. dr.
Honey of Rose, 34 parts, or	4½ fl. oz.
To make 100 parts, or	16 oz. av.

Triturate the Mercury with the Honey of Rose and Glycerin until it is extinguished. Then gradually add the Glycyrrhiza and Althæa, and continue the trituration until globules of Mercury cease to be visible under a lens magnifying ten diameters.

By using this formula the pharmacist is enabled to make blue mass extemporaneously with very little labor. The mass should not be *forcibly pressed*, or the globules of mercury will run together, and will grow larger instead of smaller.

Uses.—The object of this preparation is to furnish mercury in a finely-divided condition. It is given to produce salivation in small doses, and in doses of three to ten grains, as an alterative or purgative.

HYDRARGYRUM CUM CRETA. *U. S.* Mercury with Chalk.

Mercury, 38 parts, or	167 gr.
Sugar of Milk, in fine powder, 12 parts, or	53 gr.
Prepared Chalk, 50 parts, or	218 gr.
Ether,	
Alcohol, each, a sufficient quantity,	
To make 100 parts, or about	1 oz. av.

Mix the Mercury, Sugar of Milk, and *twelve parts* [or 53 grains] of the Chalk in a suitable mortar; moisten the mass with a mixture of *equal parts* of Ether and Alcohol, and triturate it briskly. Gradually add the remainder of the Chalk, dampen the powder occasionally with a mixture of Ether and Alcohol made in the same proportions as before, and continue the trituration until globules of Mercury are no longer visible under a magnifying power of ten diameters, and the powder is of a uniform, gray color, and dry.

The intention here is to furnish mercury in a finely-divided condition in the form of a powder. The above process is a very tedious one. In Matter's process, fifty-three grains of powdered acacia are substituted for the sugar of milk; this is mixed with fifty-three grains of chalk, enough water added to form a thin paste, the mercury added and triturated until extinguished. The remainder of the chalk is made into a paste with water, and added to it, and the water evaporated from the mixture in a water-bath; it is rubbed to powder when dry.

Uses.—Mercury with chalk is a mild mercurial, frequently given to children. It should be free from mercurous or mercuric oxide; through exposure to air old specimens frequently contain both. The dose is five to ten grains.

UNGUENTUM HYDRARGYRI. *U. S.* Mercurial Ointment.

This ointment is made by extinguishing four hundred and fifty parts of mercury with forty parts of compound tincture of benzoin, aided by one hundred parts of mercurial ointment; the mixture is then incorporated with two hundred and twenty-five parts each of melted lard and suet. (See Unguenta.) The object of this process is to furnish finely-divided mercury in a convenient form for external administration. The ointment is largely used, and the extemporaneous process furnishes a satisfactory preparation.

EMPLASTRUM HYDRARGYRI. *U.S.* Mercurial Plaster.

This plaster contains thirty parts of finely-divided mercury extinguished by ten parts each of melted resin and olive oil, and then incorporated with fifty parts of melted lead plaster, the whole being thoroughly mixed whilst cooling. (See Emplastra.) Its uses are the same as those of the ointment, metallic mercury in a finely-divided condition being present in both, the only difference being in the form of the preparations.

EMPLASTRUM AMMONIACI CUM HYDRARGYRO. *U.S.* Ammoniac Plaster with Mercury.

This plaster contains 18 per cent. of mercury with ammoniac, olive oil, sublimed sulphur, diluted acetic acid, and lead plaster. (See Emplastra.) Its uses are the same as those of mercurial plaster: it is a milder external application.

HYDRARGYRUM AMMONIATUM. *U.S.* Ammoniated Mercury.

[White Precipitate. Mercurammonium Chloride.]

NH_2HgCl; 251.1.

Corrosive Chloride of Mercury, 10 parts, or	1 oz. av.
Water of Ammonia,	
Distilled Water, each, a sufficient quantity,	
To make about	400 grains.

Dissolve the Corrosive Chloride of Mercury in *two hundred parts* [or 20 fl. oz.] of warm Distilled Water; filter the solution and allow it to cool. Pour the filtrate gradually, and constantly stirring, into *fifteen parts* [or 1½ fl. oz.] of Water of Ammonia, taking care that the latter shall remain in slight excess. Collect the precipitate upon a filter, and, when the liquid has drained from it as much as possible, wash it twice with a mixture of *twenty parts* [or 2 fl. oz.] of Distilled Water and *one part* [or 50 minims] of Water of Ammonia. Finally, dry the precipitate, between sheets of bibulous paper, in a dark place, at a temperature not exceeding 30° C. (86° F.).

In this process the ammonium of one-half of the ammonium chloride, which is formed upon mixing the solutions, has two of its hydrogen atoms replaced by one atom of bivalent mercury, NH_4Cl becoming NH_2HgCl.

$$\underset{\text{Mercuric Chloride.}}{HgCl_2} + \underset{\text{Water of Ammonia.}}{2NH_4HO} = \underset{\text{Ammonium Chloride.}}{NH_4Cl} + \underset{\text{Mercurammonium Chloride.}}{NH_2HgCl} + \underset{\text{Water.}}{2H_2O}.$$

Hydrargyrum Ammoniatum. *U.S.*	Odor and Taste.	Solubility.	
		Water.	Alcohol.
White, pulverulent pieces, or a white powder, permanent in the air. At a temperature below a red heat the salt is decomposed without fusion, and at a red heat it is wholly volatilized. When heated with solution of potassa, the salt becomes yellow and evolves vapor of ammonia.	Odorless; tasteless.	Cold. Insoluble. Boiling. Insoluble.	Cold. Insoluble. Boiling. Insoluble.

Tests for Identity.	Impurities.	Tests for Impurities.
It is completely soluble in a cold solution of hyposulphite of sodium, with evolution of ammonia; on heating this solution for a short time, it separates red mercuric sulphide, which, on protracted boiling, turns black.	Mercurous Salt.	The salt should be soluble in hydrochloric acid without residue.
	Carbonate.	The salt should be soluble in hydrochloric acid without effervescence.
	Lead.	Its solution in acetic acid should not be rendered turbid by diluted sulphuric acid.

Uses.—This compound of mercury is not used internally: it is applied externally in the form of ointment.

UNGUENTUM HYDRARGYRI AMMONIATI. *U.S.* Ointment of Ammoniated Mercury.

This ointment is made by incorporating ten parts of ammoniated mercury with ninety parts of benzoinated lard. It is a valuable application in certain forms of eczema and psoriasis and other skin diseases.

HYDRARGYRI CHLORIDUM CORROSIVUM. *U.S.* Corrosive Chloride of Mercury.

$HgCl_2$; 270.5. [Corrosive Sublimate. Mercuric Chloride.]

Preparation.—This important mercuric salt may be made by the former officinal process, as follows:

Take of Mercury 24 oz.; Sulphuric Acid 36 oz.; Chloride of Sodium 18 oz. Boil the Mercury with the Sulphuric Acid, by means of a sand-bath, until a dry white mass is left. Rub this, when cold, with the Chloride of Sodium in an earthen-ware mortar; then sublime with a gradually increasing heat.

By boiling sulphuric acid in excess with mercury to dryness a white salt (mercuric sulphate) is formed, according to the reaction

$$\underset{\text{Sulphuric Acid.}}{2H_2SO_4} + \underset{\text{Mercury.}}{Hg} = \underset{\text{Mercuric Sulphate.}}{HgSO_4} + \underset{\text{Sulphurous Acid.}}{SO_2} + \underset{\text{Water}}{2H_2O}.$$

When this is mixed with sodium chloride, and the mixture exposed to a subliming heat, decomposition takes place, according to the reaction

$$\underset{\text{Mercuric Sulphate.}}{HgSO_4} + \underset{\text{Sodium Chloride.}}{(NaCl)_2} = \underset{\text{Sodium Sulphate.}}{Na_2SO_4} + \underset{\text{Mercuric Chloride.}}{HgCl_2}.$$

The mercuric chloride thus formed sublimes, and the sodium sulphate remains behind.

Hydrargyri Chloridum Corrosivum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Heavy, colorless, rhombic crystals or crystalline masses, permanent in the air. When heated to about 265° C. (509° F.), the salt fuses; at a higher temperature it sublimes unchanged, and without residue.	Odorless; acrid and persistent metallic taste; acid reaction.	Cold. 16 parts. Boiling. 2 parts.	Cold. 3 parts. Boiling. 1.2 parts.	Soluble in 4 parts of ether.

Tests for Identity.	Impurities.	Test for Impurities.
The aqueous solution of the salt yields a reddish or yellowish precipitate on the addition of lime-water, and, on the addition of test-solution of nitrate of silver, a white precipitate insoluble in nitric acid but soluble in ammonia.	Arsenic.	If 1 Gm. of the salt be dissolved in boiling water, then mixed with 5 C.c. of strong solution of soda (sp. gr. about 1.260) in a long test-tube, and about 0.5 Gm. of fine aluminium wire, cut into small pieces, be added (a loose plug of cotton being pushed a short distance down the tube), the generated gas should not impart any tint to paper wet with test-solution of nitrate of silver and kept over the mouth of the test-tube for half an hour.

This chloride is always sublimed in masses, to distinguish it from mercurous chloride, or calomel, which is in powder.

Uses.—Pharmaceutically, mercuric chloride is used in several preparations to furnish the mercury in the compounds. Medicinally, as an alterative, it is one of the most valuable internal remedies in syphilis and chronic rheumatism. Externally, it is used as a stimulant and escharotic. Recently it has been very extensively employed in antiseptic surgery. It is undoubtedly the most powerful antiseptic available, the only serious disadvantage being the necessity for great care on account of its poisonous properties. The antidote to poisoning by corrosive sublimate is the free use of white of egg, milk, or other albuminous liquids, followed by an emetic.

HYDRARGYRI CHLORIDUM MITE. *U. S.* Mild Chloride of Mercury.

Hg_2Cl_2; 470.2. [Calomel. Mercurous Chloride.]

Preparation.—The former officinal process may be used to prepare mercurous chloride, as follows:

Take of Mercury 48 oz.; Sulphuric Acid 36 oz.; Chloride of Sodium 18 oz.; Distilled Water a sufficient quantity. Boil, by means of a sand-bath, 24 oz. of the Mercury with the Sulphuric Acid, until a dry white mass is left. Rub this, when cold, with the remainder of the Mercury, in an earthen-ware mortar, until they are thoroughly mixed. Then add the Chloride of Sodium, and, having rubbed it with the other ingredients until globules of Mercury cease to be visible, sublime the mixture into a large chamber so that the sublimate may fall in powder. Wash the sublimed matter with boiling Distilled Water, until the washings afford no precipitate with water of ammonia, and dry it.

In this preparation mercuric sulphate is first formed; this is then triturated with a quantity of mercury equal to that used in forming it; mercurous sulphate is produced, and when this is mixed with sodium chloride and sublimed, mercurous chloride is produced as a fine white sublimate, and sodium sulphate remains behind.

$$\underset{\text{Sulphuric Acid.}}{2H_2SO_4} + \underset{\text{Mercury.}}{Hg} = \underset{\text{Mercuric Sulphate.}}{HgSO_4} + \underset{\text{Sulphurous Acid.}}{SO_2} + \underset{\text{Water.}}{2H_2O}.$$

$$\underset{\text{Mercuric Sulphate.}}{HgSO_4} + \underset{\text{Mercury.}}{Hg} = \underset{\text{Mercurous Sulphate.}}{Hg_2SO_4}.$$

$$\underset{\text{Mercurous Sulphate.}}{Hg_2SO_4} + \underset{\text{Sodium Chloride.}}{2NaCl} = \underset{\text{Mercurous Chloride.}}{Hg_2Cl_2} + \underset{\text{Sodium Sulphate.}}{Na_2SO_4}.$$

Hydrargyri Chloridum Mite. *U.S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A white, impalpable powder, permanent in the air. When strongly heated, it is wholly volatilized, without melting. The salt is blackened by water of ammonia. A portion heated in a dry glass tube with dried carbonate of sodium yields metallic mercury.	Odorless; tasteless.	Insoluble.	Insoluble.	Insoluble in ether.

Tests for Identity.	Impurities.	Tests for Impurities.
On heating the salt with solution of potassa, no odor of ammonia should be evolved; and acetic acid, agitated with the salt and filtered, should remain unaffected by hydrosulphuric acid or by test-solution of nitrate of silver (absence of and difference from ammoniated mercury).	Mercuric Chloride.	Distilled water or alcohol, after having been agitated with a portion of the salt, and filtered, should not be affected by hydrosulphuric acid nor by test-solution of nitrate of silver.
	Fixed soluble impurities.	Distilled water or alcohol, after having been agitated with a portion of the salt, and filtered, should not leave any residue on evaporation.

Uses.—Calomel is largely used as a hepatic stimulant and alterative; it is also purgative, and in large doses sedative. It is given in doses of one-half grain to twenty grains. Care must be exercised in prescribing calomel with other remedies that the chemical action does not produce corrosive sublimate. (See U. S. Dispensatory, 15th ed., page 756.)

HYDRARGYRI CYANIDUM. *U.S.* Cyanide of Mercury.

$Hg(CN)_2$; 251.7. [Mercuric Cyanide.]

Preparation.—This compound may be made by a former officinal process, as follows:

Take of Ferrocyanide of Potassium, 5 oz. troy; Sulphuric Acid, 4 oz. troy 120 gr.; Red Oxide of Mercury, in fine powder, Water, each, a sufficient quantity. Dissolve the Ferrocyanide of Potassium in 20 fl. oz. of Water, and add the solution to the Sulphuric Acid, previously diluted with 10 fl. oz. of Water, and contained in a glass retort. Distil the mixture nearly to dryness into a receiver, containing 10 fl. oz. of Water and 3 oz. troy of Red Oxide of Mercury. Set aside 2 fl. oz. of the distilled liquid, and to the remainder add, with agitation, sufficient Red Oxide to destroy the odor of hydrocyanic acid. Then filter the solution, and, having added the reserved liquid, evaporate the whole in a dark place, in order that crystals may form. Lastly, dry the crystals, and keep them in a well-stopped bottle, protected from the light.

The object of this process is to produce hydrocyanic acid by decomposing potassium ferrocyanide with sulphuric acid, and to conduct the vapor into a receiving vessel containing mercuric oxide and water. Mercuric cyanide is produced; this dissolves in the water, and the solution is evaporated and crystallized.

$$\underset{\text{Hydrocyanic Acid.}}{(HCN)_2} + \underset{\text{Mercuric Oxide.}}{HgO} = \underset{\text{Mercuric Cyanide.}}{Hg(CN)_2} + \underset{\text{Water.}}{H_2O}.$$

Hydrargyri Cyanidum. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless or white, prismatic crystals, becoming dark-colored on exposure to light.	Odorless; bitter, metallic taste; neutral reaction.	Cold. 12.8 parts. Boiling. 3 parts.	Cold. 15 parts. Boiling. 6 parts.

Tests for Identity.	Impurities.	Test for Impurities.
When slowly heated, the salt decomposes into metallic mercury and cyanogen gas, which is inflammable, burning with a purplish flame. On further heating, the blackish residue, containing globules of metallic mercury, is wholly dissipated. On adding hydrochloric acid to the aqueous solution, hydrocyanic acid vapor is evolved.	Mercuric Chloride.	A 5 per cent. aqueous solution of the salt, when mixed with a dilute aqueous solution of iodide of potassium, should not yield a red or reddish precipitate soluble in excess of either liquid.

Uses.—This cyanide is used as an alterative in syphilis, in doses of one-sixteenth to one-eighth of a grain.

HYDRARGYRI IODIDUM RUBRUM. *U. S.* Red Iodide of Mercury.

HgI_2; 452.9. [Biniodide of Mercury. Mercuric Iodide.]

Corrosive Chloride of Mercury, 9 parts, or	1 oz. av.
Iodide of Potassium, 11 parts, or	535 grains.
Distilled Water, a sufficient quantity,	
To make about	1½ oz. av.

Dissolve the Corrosive Chloride of Mercury in *one hundred and fifty parts* [or 1 pint] of warm Distilled Water, and the Iodide of Potassium in *thirty parts* [or 3 fl. oz.] of Distilled Water, and filter the solutions separately. Add the solution of Corrosive Chloride of Mercury, when cold, to the solution of Iodide of Potassium, constantly stirring. Collect the precipitate on a filter, wash it with Distilled Water until the washings cease to give a precipitate with test-solution of nitrate of silver, and dry it between sheets of bibulous paper, at a temperature not exceeding 40° C. (104° F.). Keep the product in well-stopped bottles.

In this process mercuric iodide and potassium chloride are formed by double decomposition.

$$\underset{\text{Mercuric Chloride.}}{HgCl_2} + \underset{\text{Potassium Iodide.}}{2KI} = \underset{\text{Mercuric Iodide.}}{HgI_2} + \underset{\text{Potassium Chloride.}}{2KCl}.$$

As mercuric iodide is soluble in solutions both of mercuric chloride and of potassium iodide, it is not profitable to use an excess of either. It may be obtained in handsome crystals by dissolving it in hot hydrochloric acid to saturation and allowing the solution to cool slowly.

Hydrargyri Iodidum Rubrum. *U. S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A scarlet-red, crystalline powder, permanent in the air. When heated, the salt turns yellow, but reassumes its red color on cooling. On ignition, it is wholly dissipated.	Odorless; tasteless.	Almost insoluble.	Cold. 130 parts. Boiling. 15 parts.	Soluble in solution of iodide of potassium or of mercuric chloride.

Tests for Identity.	Impurities.	Test for Impurities.
On heating the salt with solution of soda and adding a little sugar of milk, metallic mercury is precipitated. If the salt be heated with sulphuric acid and some black oxide of manganese, vapor of iodine will be given off.	Soluble Iodide, Chloride.	Water agitated with the salt, and filtered, should remain unaffected by test-solution of nitrate of silver.

Uses.—This iodide is used internally in the treatment of syphilis, in doses of one-sixteenth of a grain: it is frequently given in pill form combined with potassium iodide. Externally, it is often used in the form of an ointment, of the strength of sixteen grains to the ounce, which was formerly officinal.

HYDRARGYRI IODIDUM VIRIDE. *U. S.* Green Iodide of Mercury.

[Protiodide of Mercury. Mercurous Iodide.]

Hg_2I_2; 652.6.

Mercury, 8 parts, or	1 oz. av.
Iodine, 5 parts, or	274 grains.
Alcohol, a sufficient quantity,	
To make about	1½ oz. av.

Pour about *three parts* [or 4 fl. dr.] of Alcohol into a mortar containing the Mercury, add the Iodine in several successive portions, and triturate the mixture, adding sufficient Alcohol from time to time to keep the mass constantly moist, and taking care that it shall neither become too hot, nor be exposed to light during the various steps of the process. Continue the trituration until all globules of Mercury have disappeared, and the mixture has become nearly dry and has acquired a greenish-yellow color. Then add sufficient Alcohol to reduce the whole to a thin paste, pour this into a bottle, let it stand for several days, and then wash the Iodide twice with about *fifty parts* [or 8 fl. oz.] of Alcohol each time, and decant the washings. Transfer the Iodide to a filter, and continue washing with Alcohol until the washings are no longer affected by hydrosulphuric acid. Lastly, dry the product in a dark place, between sheets of bibulous paper, at a temperature not exceeding 40° C. (104° F.). Keep the product in well-stopped bottles, protected from light.

In this process direct combination takes place between the mercury and the iodine, alcohol being added to prevent, by its evaporation, too great an elevation of temperature. Some mercuric iodide is formed at the same time; and, as this is much more active than the mercurous salt, and is soluble in alcohol, it is directed to be washed out.

Hydrargyri Iodidum Viride. *U.S.*	Quantitative Test.
A dull green to greenish-yellow powder, becoming more yellow by exposure to air, and darker by exposure to light, odorless and tasteless, almost insoluble in water, and wholly insoluble in alcohol or ether. When strongly heated, the salt is volatilized without residue. When added to a solution of iodide of potassium, the salt is decomposed into metallic mercury, which precipitates, and mercuric iodide, which dissolves.	If 10 C.c. of alcohol are shaken with 1 Gm. of the salt and filtered, the filtrate should not produce more than a very faint, transient opalescence when dropped into water; and when 5 C.c. of the filtrate are evaporated from a white porcelain surface, not more than a very faint red stain should remain behind.

Uses.—Green iodide of mercury is used as an alterative. It is better adapted for internal administration than the red iodide, because it is milder. The dose is one grain.

HYDRARGYRI OXIDUM FLAVUM. *U.S.* **Yellow Oxide of Mercury.**

HgO; 215.7. [Yellow Mercuric Oxide.]

Corrosive Chloride of Mercury, 1 part, or . . . . . 1 oz. av.
Solution of Potassa, 9 parts, or . . . . . 8½ fl. oz.
Distilled Water, a sufficient quantity.

Dissolve the Corrosive Chloride of Mercury in *one hundred parts* [or about 6 pints] of warm Distilled Water, and filter the solution. Pour the filtrate into the Solution of Potassa, previously diluted with *one hundred parts* [or 6 pints] of Distilled Water, stirring constantly, and set the liquid containing the precipitate aside for twenty-four hours. Then decant the supernatant, clear liquid from the precipitate, and wash the latter repeatedly by the affusion and decantation of Distilled Water, using about *one hundred parts* [or 6 pints] of Water each time. Continue the washing on a strainer until the washings cease to be affected by test-solution of nitrate of silver. Let the precipitate drain, and dry it, between sheets of bibulous paper, in a dark place, at a temperature not exceeding 40° C. (104° F.). Keep the product in well-stopped bottles, protected from light.

$$\underset{\text{Mercuric Chloride.}}{HgCl_2} + \underset{\text{Potassium Hydrate.}}{2KHO} = \underset{\text{Mercuric Oxide.}}{HgO} + \underset{\text{Potassium Chloride.}}{2KCl} + \underset{\text{Water.}}{H_2O}.$$

Hydrargyri Oxidum Flavum. *U.S.*	Test for Identity.
A light orange-yellow, heavy, impalpable powder, permanent in the air, and turning darker on exposure to light. When strongly heated, it assumes a red color; at a higher temperature it is decomposed, giving off oxygen and separating metallic mercury, and is finally volatilized without residue.	The difference between this oxide and red mercuric oxide is that when this is digested, on a water-bath, for fifteen minutes, with a strong solution of oxalic acid, it forms mercuric oxalate of a white color.

Uses.—Yellow mercuric oxide is used in making the oleate of mercury and in the officinal ointment: it is employed only externally.

UNGUENTUM HYDRARGYRI OXIDI FLAVI. *U.S.* **Ointment of Yellow Oxide of Mercury.**

This preparation is made by incorporating ten parts of yellow mercuric oxide with ninety parts of ointment. Its uses are the same as those of the older ointment of red mercuric oxide. (See Unguenta.)

OLEATUM HYDRARGYRI. *U.S.* **Oleate of Mercury.**

This oleate is made by dissolving ten parts of dried yellow oxide of mercury in ninety parts of oleic acid. It is best to avoid heat in making this preparation, to prevent partial decomposition and separation of metallic mercury; in time this change slowly takes place, even when the directions have been strictly followed (see page 289).

HYDRARGYRI OXIDUM RUBRUM. *U.S.* **Red Oxide of Mercury.**

HgO; 215.7. [RED PRECIPITATE. RED MERCURIC OXIDE.]

Preparation.—This oxide may be made by a former officinal process, as follows:

Take of Mercury 36 oz.; Nitric Acid 24 oz.; Water 2 pints. Dissolve the Mercury, with the aid of a gentle heat, in the Acid and Water previously mixed, and evaporate to dryness. Rub the dry mass into powder, and heat it in a very shallow vessel until red vapors cease to rise.

Mercuric nitrate is first formed, and this is decomposed by heat.

$$\underset{\text{Mercuric Nitrate.}}{(Hg2NO_3)_2} = \underset{\text{Mercuric Oxide.}}{(HgO)_2} + \underset{\text{Nitrogen Dioxide.}}{4NO_2} + \underset{\text{Oxygen.}}{O_2}.$$

It is more economical to add an equal weight of mercury to the mercuric nitrate, before heating, as it also may be converted into oxide through the escaping nitrogen dioxide and heat.

Hydrargyri Oxidum Rubrum. *U.S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Heavy, orange-red, crystalline scales, or a crystalline powder, becoming more yellow the finer it is divided, permanent in the air. At a high temperature it is decomposed, giving off oxygen and separating metallic mercury, and is finally volatilized without residue.	Odorless; tasteless.	Insoluble.	Insoluble.	Wholly soluble in nitric or hydrochloric acid.

Test for Identity.	Impurities.	Test for Impurities.
When digested, on a water-bath, with a strong solution of oxalic acid, it does not change color within two hours (difference from yellow mercuric oxide).	Nitrate.	When strongly heated, it turns darker, without emitting reddish fumes.

Uses.—Red mercuric oxide has the same chemical composition as the yellow oxide. It is used in the form of ointment for inflamed eyelids, in skin diseases, and for destroying body-vermin.

UNGUENTUM HYDRARGYRI OXIDI RUBRI. *U.S.* Ointment of Red Oxide of Mercury.

This preparation, usually known as red precipitate ointment, is made by incorporating ten parts of red mercuric oxide with ninety parts of ointment. It is used as a stimulating application to indolent sores and in blepharitis.

HYDRARGYRI SUBSULPHAS FLAVUS. *U.S.* Yellow Subsulphate of Mercury.

$Hg(HgO)_2SO_4$; 727.1. [Basic Mercuric Sulphate. Turpeth Mineral.]

Mercury, 10 parts, or	4 oz. av.
Sulphuric Acid, 5 parts, or	2 oz. av.
Nitric Acid, 4 parts, or	9 fl. dr.
Distilled Water, a sufficient quantity.	

Upon the Mercury, contained in a capacious flask, pour the Sulphuric Acid, then gradually add the Nitric Acid, previously mixed with *three parts* [or 1 fl. oz.] of Distilled Water, and digest at a gentle heat until reddish fumes are no longer given off. Transfer the mixture to a porcelain capsule, and heat it on a sand-bath, frequently stirring, until a dry, white mass remains. Reduce this to a fine powder and throw it, in small portions at a time, and constantly stirring, into *two hundred parts* [or 5 pints] of boiling Distilled Water. When all has been added, continue the boiling for ten minutes, then allow the mixture to settle, decant the supernatant liquid, transfer the precipitate to a strainer, wash it with warm Distilled Water until the washings no longer have an acid reaction, and dry it in a moderately warm place.

When normal mercuric sulphate ($HgSO_4$) is mixed with boiling water it is decomposed, and basic mercuric sulphate, $Hg(HgO)_2SO_4$, separates, as a yellow precipitate, whilst acid mercuric sulphate remains in solution.

Hydrargyri Subsulphas Flavus. *U.S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A heavy, lemon-yellow powder, permanent in the air. When heated, the salt turns red, becoming yellow again on cooling. At a red heat it is volatilized without residue, evolving vapors of mercury and of sulphurous acid.	Odorless; almost tasteless.	Insoluble.	Insoluble.	Soluble in nitric or hydrochloric acid.

Test for Identity.

To prove the absence of mercurous salt, this compound should be soluble in 20 parts of hydrochloric acid without residue.

Uses.—This mercurial salt is rarely used. It is powerfully irritant, and may be replaced by milder mercurials with advantage. The dose, as an alterative, is from one-quarter to one-half grain.

HYDRARGYRI SULPHIDUM RUBRUM. *U. S.* **Red Sulphide of Mercury.**

HgS; 231.7. [RED MERCURIC SULPHIDE. CINNABAR.]

Preparation.—This compound may be made by the process formerly officinal, as follows:

Take of Mercury 40 oz.; Sulphur 8 oz. To the Sulphur, previously melted, gradually add the Mercury, with constant stirring, and continue the heat until the mass begins to swell. Then remove the vessel from the fire, and cover it closely to prevent the contents from inflaming. When the mass is cold, rub it into powder, and sublime.

Red mercuric sulphide is known in the arts as *vermilion:* it is made on a large scale in China, Austria, Holland, England, and the United States. The manufacturers carefully guard their secrets concerning their method of obtaining a very brilliant color. The above process will not yield a product equal to the Chinese vermilion as a pigment.

Hydrargyri Sulphidum Rubrum. *U. S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Brilliant, dark red, crystalline masses, or a fine, bright, scarlet powder, permanent in the air.	Odorless; tasteless.	Insoluble.	Insoluble.	Insoluble in nitric or hydrochloric acid, or in dilute solutions of alkalies. Dissolved by nitrohydrochloric acid with separation of sulphur.

Tests for Identity.	Impurities.	Tests for Impurities.
When heated, the salt becomes brown and then black, but, on cooling, it reassumes its red color. At a higher temperature it takes fire, burns with a bluish flame, emitting the odor of burning sulphur, and is finally volatilized without residue. On dissolving the salt in nitrohydrochloric acid and adding an excess of stannous chloride, metallic mercury is precipitated.	Arsenic, Antimony.	If the salt be treated with warm solution of potassa, the filtrate, after being acidulated with hydrochloric acid, should not yield a yellow or orange-colored precipitate.
	Chromates, Iodides, or other Sulphides.	If the salt be treated with warm solution of potassa, the filtrate, after being acidulated with hydrochloric acid, should not produce a colored precipitate with acetate of lead.
	Red Oxide of Mercury or of Lead.	If the salt be digested with diluted nitric acid for five minutes, the filtrate, after being much diluted, should not be darkened by hydrosulphuric acid.

Uses.—This compound is used medicinally by fumigation, a small portion being thrown on a red-hot shovel and the fumes inhaled.

LIQUOR HYDRARGYRI NITRATIS. *U. S.* **Solution of Nitrate of Mercury.**

[SOLUTION OF MERCURIC NITRATE.]

A liquid containing in solution about 50 per cent. of Mercuric Nitrate [$Hg(NO_3)_2$; 327.7], with some free Nitric Acid.

Red Oxide of Mercury, 40 parts, or	4 oz. av.
Nitric Acid, 45 parts, or	3 fl. oz.
Distilled Water, 15 parts, or	1 fl. oz. 3½ fl. dr.
To make 100 parts, or . . . about	4½ fl. oz.

Mix the Nitric Acid with the Distilled Water, and dissolve the Red Oxide of Mercury in the mixture. Keep the solution in glass-stoppered bottles.

Liquor Hydrargyri Nitratis. *U. S.*	Odor and Reaction.	Solubility.
A clear, nearly colorless, heavy liquid. Sp. gr. 2.100. A few drops evaporated on platinum foil leave a white residue, which, on heating, becomes yellow, red, and brown, and is finally entirely volatilized. On a bright surface of copper, the Solution deposits a coating of mercury.	Faint odor of nitric acid; strongly acid reaction.	Miscible in all proportions with water and alcohol.

Tests for Identity.	Impurities.	Test for Impurities.
The diluted Solution affords, with solution of potassa, a yellow precipitate, and with iodide of potassium, a bright red one, soluble in excess of the iodide. A crystal of ferrous sulphate, dropped into the Solution, rapidly acquires a brown color and becomes surrounded by a brownish-black zone.	Mercurous Salt.	No precipitation or cloudiness should occur in the Solution on the addition of distilled water or of diluted hydrochloric acid.

Uses.—This is a corrosive liquid, used principally to cauterize malignant ulcerations, cancers, etc. It is never given internally.

UNGUENTUM HYDRARGYRI NITRATIS. *U. S.* Ointment of Nitrate of Mercury.

[Citrine Ointment.]

This important ointment is made by heating seventy-six parts of lard oil to a temperature of 70° C. (158° F.), and then adding, *without stirring*, seven parts of nitric acid, continuing the heat as long as moderate effervescence continues, and then allowing the mixture to cool; seven parts of mercury are dissolved in ten parts of nitric acid with the aid of sufficient heat, and this solution is added to the ointment before it has become entirely cold. When nitric acid is added to lard oil under the above circumstances, the *olein* of the oil is converted into elaïdin, and the color changes to a deep orange: this, upon stirring and cooling, becomes lighter, and it has received the name of citrine ointment. It is used in various skin diseases and in inflammation of the eyelids. (See Unguenta.)

CHAPTER XLVII.

ANTIMONY, ARSENIC, AND BISMUTH.

Sb; 120. As; 74.9. Bi; 210.

THESE three metals form a group which presents several analogies. Arsenic is regarded by a number of chemists as not metallic, and on account of some of its chemical relations it is classed by them with the non-metallic elements, but in some of its physical properties, notably its lustre, specific gravity, etc., it closely resembles the metals, and it is therefore considered in the group with antimony and bismuth.

Antimony (Stibium). Sb; 120.

This metal is found in nature in a free state, and as a sulphide, oxide, or oxysulphide. The native sulphide is the chief source of the metal, and roasting with iron and sodium sulphide is the process generally resorted to for obtaining it. It is a brittle, brilliant metal, of a lamellated texture, of a silver-white color when pure, but bluish-white as it occurs in commerce. When rubbed between the fingers, it imparts a sensible odor. Its sp. gr. is 6.7, and its fusing point 425° C. (797° F.), or about a red heat. It forms three combinations with oxygen,—*antimony trioxide* (antimonous oxide), Sb_2O_3, *antimony tetroxide*, Sb_2O_4 (by some considered to be an antimonate of the teroxide of antimony, Sb_4O_8), and *antimony pentoxide* (antimonic oxide), Sb_2O_5. The first of these unites with water to form antimonous acid, the salts of which are called *antimonites;* the third unites with water to form antimonic acid, the salts of which are called *antimonates.*

Tests for Salts of Antimony.

1. If hydrosulphuric acid be added to an acidified solution of salt of antimony, an orange-red precipitate of sulphide will be produced. This is soluble in ammonium sulphide, but is again precipitated upon the addition of an acid.

2. If hydrochloric acid be added to the sulphide, so as to form a strong solution of antimonous chloride, and this be mixed with water, a white precipitate of oxychloride will be produced.

3. Zinc and iron precipitate antimony as a black powder from its solutions, copper precipitates it as a metallic film; this may be dissolved by potassium permanganate, and this solution will yield antimony sulphide with hydrosulphuric acid.

Officinal Preparations of Antimony.

Officinal Name.	Preparation.
Antimonii et Potassii Tartras	By boiling antimonous oxide and acid potassium tartrate together with water, evaporating and crystallizing.
Antimonii Oxidum	By adding antimonous chloride to water, and treating the oxychloride formed with water of ammonia.
Antimonii Sulphidum	By purifying antimony ore by fusion.
Antimonii Sulphidum Purificatum	By macerating antimonous sulphide with water containing a trace of water of ammonia.
Antimonium Sulphuratum	By boiling antimonous sulphide with solution of soda and adding sulphuric acid to the hot solution.
Pilulæ Antimonii Compositæ	Each pill contains ½ gr. sulphurated antimony, ½ gr. mild chloride of mercury, and 1 gr. guaiac.
Pulvis Antimonialis	33 parts antimonous oxide, 67 parts precipitated calcium phosphate.
Vinum Antimonii	4 parts tartrate of antimony and potassium, 60 parts distilled water, stronger white wine, to make 1000 parts.

Unofficinal Salts of Antimony.

Antimonii Bromidum, $SbBr_3$, = 360. Bromide of Antimony.	By adding dry antimony to bromine contained in a retort, agitating until the combination is complete, then purifying by distillation, and collecting the crystals.
Antimonii Fluoridum, $SbFl_3$. Fluoride of Antimony.	By placing antimony and mercury fluoride in a retort, distilling, and collecting the white mass.
Antimonii Iodidum, SbI_3, = 379.8. Iodide of Antimony.	By direct combination of the elements.
Antimonii Oxysulphidum, Sb_2S_3 and Sb_2O_3. Oxysulphide of Antimony.	By boiling 1 p. black antimony with 250 p. water containing 23 p. sodium carbonate, filtering, and collecting the precipitate.
Antimonii Pentasulphidum. Pentasulphide of Antimony.	By adding 70 p. crystallized sodium carbonate to 250 p. water and boiling; then mixing with 26 p. lime and 80 p. water; lastly, adding 36 p. levigated sulphide of antimony and 7 p. sublimed sulphur, boiling until gray color disappears, filtering, and then crystallizing.
Antimonii Sulphas, $Sb_2(SO_4)_3$, = 526. Sulphate of Antimony.	By boiling antimony with strong sulphuric acid, and collecting the white mass.

ANTIMONII ET POTASSII TARTRAS. *U.S.* Tartrate of Antimony and Potassium.

$2KSbOC_4H_4O_6.H_2O$; 664. [TARTAR EMETIC.]

This, the most important antimonial compound, may be made by a former officinal process, as follows:

Take of Oxide of Antimony, in very fine powder, 2 oz.; Bitartrate of Potassium, in very fine powder, 2½ oz.; Distilled Water, 18 fl. oz. To the Water, heated to the boiling point in a glass vessel, add the powders, previously mixed, and boil for an hour; then filter the liquid while hot, and set it aside that crystals may form. Lastly, dry the crystals, and keep them in a well-stopped bottle. By further evaporation the mother-water may be made to yield more crystals, which should be purified by a second crystallization.

Like potassium and sodium tartrate, this is a double salt. Two replaceable hydrogen atoms of tartaric acid ($H_2C_4H_4O_6$) are substituted by one of antimonyl (SbO) and one of potassium (K). The group (SbO) is hypothetical.

$$\underset{\text{Acid Potassium Tartrate.}}{2KHC_4H_4O_6} + \underset{\text{Antimonous Oxide.}}{Sb_2O_3} = \underset{\text{Antimony Potassium Tartrate.}}{2KSbOC_4H_4O_6} + \underset{\text{Water.}}{H_2O.}$$

Antimonii et Potassii Tartras. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Small, transparent crystals of the rhombic system, becoming opaque and white on exposure to air, or a white granular powder. When heated to redness, the salt chars, emits the odor of burnt sugar, and leaves a blackened residue of an alkaline reaction.	Sweet, afterwards disagreeable, metallic taste; feebly acid reaction.	Cold. 17 parts. Boiling. 3 parts.	Insoluble. It precipitates it from its aqueous solution in form of a crystalline powder.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution of the salt yields, with hydrochloric acid, a white precipitate soluble in an excess of the acid; but no precipitate occurs if tartaric acid has been previously added. In a solution of the salt acidulated with hydrochloric acid, hydrosulphuric acid causes an orange-red precipitate. A dilute solution at once becomes permanently turbid on the addition of a little carbonate of potassium.	Sulphate.	A 1 per cent. aqueous solution of the salt, previously acidulated with acetic acid, should not be clouded by the addition of a few drops of test-solution of chloride of barium.
	Iron and other Metals.	A 1 per cent. aqueous solution of the salt, previously acidulated with acetic acid, should not be clouded by the addition of a few drops of test-solution of ferrocyanide of potassium.
	Calcium.	A 1 per cent. aqueous solution of the salt, previously acidulated with acetic acid, should not be clouded by the addition of a few drops of test-solution of oxalate of ammonium.
	Chloride.	A 1 per cent. aqueous solution of the salt, previously acidulated with acetic acid, should not be clouded by the addition of a few drops of test-solution of nitrate of silver.
	More than traces of Arsenic.	If 1 Gm. of the salt and some pieces of aluminium wire be added to strong solution of soda (sp. gr. about 1.260), contained in a long test-tube, a gas is given off which should not impart any color to filtering paper wet with test-solution of nitrate of silver and held over the mouth of the test-tube.

Uses.—Tartar emetic, as its name implies, is used as an emetic, in doses of half a grain to one grain, repeated until vomiting takes place. It is given in minute doses as an alterative or diaphoretic. In cases of poisoning by an overdose, tannin should be administered in some form, freely: the insoluble tannate is formed.

ANTIMONII OXIDUM. *U.S.* Oxide of Antimony.

Sb_2O_3; 288.

Preparation.—The former officinal process may be used in making this oxide. It is as follows:

Take of Sulphide of Antimony, in very fine powder, 4 oz. troy; Hydrochloric Acid, 18 oz. troy; Nitric Acid, 1 oz. troy, 120 grains; Water of Ammonia, 1½ fl. oz.; Water, Distilled Water, each, a sufficient

quantity. Introduce the Sulphide into a flask, of the capacity of two pints, and, having added the Hydrochloric Acid, digest, by means of a sand-bath, until effervescence ceases. Then, having removed the flask from the sand-bath, add the Nitric Acid gradually; and, when nitrous acid vapors cease to be given off, and the liquid has grown cold, add to it half a pint of Water, and filter. Pour the filtered liquid gradually into twelve pints of Water, constantly stirring, and allow the precipitate to subside. Decant the supernatant liquid, and wash the precipitate twice by decantation, using, each time, eight pints of Water. Then transfer it to a muslin filter to drain, and, after the draining is completed, wash it with Water until the washings cease to have an acid reaction. Next introduce it into a suitable vessel, and subject it to the action of the Water of Ammonia for two hours; at the end of which time transfer it to a moistened muslin filter, and wash it with Distilled Water as long as the washings produce a precipitate with nitrate of silver. Lastly, dry the precipitate upon bibulous paper with the aid of a gentle heat.

The first step in this process is the formation of antimonous chloride, $SbCl_3$. When this is added to water it is decomposed, an oxychloride being formed, $2SbCl_3.5Sb_2O_3$. This is converted into oxide by treating it with ammonia.

$$\underset{\text{Antimony Sulphide.}}{Sb_2S_3} + \underset{\text{Hydrochloric Acid.}}{6HCl} = \underset{\text{Antimonous Chloride.}}{2SbCl_3} + \underset{\text{Hydrosulphuric Acid.}}{3H_2S};$$

then

$$\underset{\text{Antimonous Chloride.}}{12SbCl_3} + \underset{\text{Water.}}{15H_2O} = \underset{\text{Antimony Oxychloride.}}{2SbCl_3.5Sb_2O_3} + \underset{\text{Hydrochloric Acid.}}{30HCl},$$

and

$$\underset{\text{Antimony Oxychloride.}}{2SbCl_3,5Sb_2O_3} + \underset{\text{Ammonia.}}{6NH_3} + \underset{\text{Water.}}{3H_2O} = \underset{\text{Antimony Oxide.}}{6Sb_2O_3} + \underset{\text{Ammonium Chloride.}}{6NH_4Cl}.$$

Antimonii Oxidum. *U. S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A heavy, grayish-white powder, permanent in the air.	Odorless; tasteless.	Almost insoluble.	Insoluble.	Hydrochloric acid dissolves it; soluble in warm solution of tartaric acid, and in boiling solution of bitartrate of potassium; insoluble in nitric acid.

Tests for Identity.	Impurities.	Tests for Impurities.
When heated, the Oxide turns yellow, and at a dull red heat fuses to a yellowish liquid, which concretes, on cooling, to a crystalline mass of a pearly color. At a higher temperature it sublimes, producing colorless and transparent, or white, shining, needle-shaped crystals. By dropping its solution in hydrochloric acid into water, a white precipitate is formed, which is at once changed to orange by hydrosulphuric acid.	Chloride.	A solution of Oxide of Antimony in an excess of tartaric acid should yield no precipitate with test-solution of nitrate of silver.
	Sulphate.	A solution of Oxide of Antimony in an excess of tartaric acid should yield no precipitate with test-solution of chloride of barium.
	Iron and other Metals.	A solution of Oxide of Antimony in an excess of tartaric acid should yield no precipitate with test-solution of ferrocyanide of potassium.

Uses.—This oxide is rarely given uncombined; internally, it is the active ingredient in the officinal antimonial powder (Pulvis Antimonialis). It is used in the preparation of tartar emetic.

ANTIMONII SULPHIDUM. *U. S.* Sulphide of Antimony.

Sb_2S_3; 336. [ANTIMONII SULPHURETUM, Pharm. 1870.]

Native Sulphide of Antimony, purified by fusion, and as nearly free from Arsenic as possible.

Preparation.—The crude antimony ore is purified by placing it in melting-pots, which are connected with the receiving-pots by earthenware tubes; the infusible substances remain in the melting-pots, and are separated from the fused mass, and the latter, when cold, in the form of conical masses or loaves, is called *crude antimony.*

Antimonii Sulphidum. *U. S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Steel-gray masses of a metallic lustre and a striated, crystalline fracture, forming a black or grayish-black, lustreless powder. When heated, it fuses at a temperature below red heat.	Odorless; tasteless.	Insoluble.	Insoluble.	1 part of powdered sulphide, when boiled with 10 parts of hydrochloric acid, dissolves without leaving more than a slight residue, hydrosulphuric acid being evolved.

Tests for Identity.

The solution when added to water gives a white precipitate, which is soluble in a solution of tartaric acid. After separation of the precipitate by filtration, the filtrate gives an orange-red precipitate with hydrosulphuric acid.

Uses.—Sulphide of antimony is used almost exclusively in veterinary practice as an alterative.

ANTIMONII SULPHIDUM PURIFICATUM. *U. S.* Purified Sulphide of Antimony.

Sb_2S_3; 336.

Sulphide of Antimony, 10 parts, or . . . . . 16 oz. av.
Water of Ammonia, 5 parts, or . . . . . 8½ fl. oz.
Water, a sufficient quantity.

Reduce the Sulphide of Antimony to a very fine powder. Separate the coarser particles by elutriation, and, when the finely-divided sulphide has been deposited, pour off the water, add the Water of Ammonia, and macerate for five days, agitating the mixture frequently. Then let the powder settle, pour off the Water of Ammonia, and wash the residue by repeated affusion and decantation of water. Finally, dry the product by the aid of heat.

The intention of this process is to purify the commercial sulphide from arsenious sulphide, the latter being soluble in ammonia. Hager prefers to use a solution of ammonium carbonate with the ammonia, because it is more economical, antimony sulphide being less soluble in the mixture.

Antimonii Sulphidum Purificatum. *U.S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A dark gray powder. It fuses at a temperature below red heat.	Odorless; tasteless.	Insoluble.	Insoluble.	When boiled with 10 parts of hydrochloric acid it is nearly all dissolved, hydrosulphuric acid being evolved.

Tests for Identity.	Impurities.	Tests for Impurities.
The solution, when added to water, yields a white precipitate, which is soluble in a solution of tartaric acid. After separation of the precipitate by filtration, the filtrate gives an orange-red precipitate with hydrosulphuric acid.	Other Metallic Sulphides.	If 2 Gm. of the salt be mixed and cautiously ignited, in a porcelain crucible, with 8 Gm. of pure nitrate of sodium, and the fused mass boiled with 25 Gm. of water, there will remain a residue which should be white, or nearly so, and not yellowish nor brownish.
	More than traces of Arsenic.	On boiling the above filtrate with an excess of nitric acid, until no more nitrous vapors are evolved, then dissolving in it 0.1 Gm. of nitrate of silver, filtering again, if necessary, and cautiously pouring a few drops of water of ammonia on top, not more than a white cloud, but no red nor reddish precipitate, should appear at the line of contact of the two liquids.

Uses.—Purified sulphide of antimony should be used exclusively in all the preparations into which the sulphide enters. It is not used internally to any extent.

ANTIMONIUM SULPHURATUM. *U.S.* Sulphurated Antimony.

Chiefly Antimonious Sulphide [Sb_2S_3; 336], with a very small amount of Antimonious Oxide.

Purified Sulphide of Antimony, 1 part, or . . . . . 4 oz. av.
Solution of Soda, 12 parts, or . . . . . 2 pints 13 fl. oz.
Distilled Water,
Diluted Sulphuric Acid, each, a sufficient quantity.

Mix the Purified Sulphide of Antimony with the Solution of Soda and *thirty parts* [or 8 pints] of Distilled Water, and boil the mixture over a gentle fire, for two hours, constantly stirring, and occasionally adding Distilled Water so as to preserve the same volume. Strain the liquid immediately through a double muslin strainer, and drop into it, while yet hot, Diluted Sulphuric Acid so long as it produces a precipitate. Wash the precipitate with hot Distilled Water until the washings are at most but very slightly clouded by test-solution of chloride of barium; then dry the precipitate and rub it to a fine powder.

When antimonous sulphide is boiled with solution of sodium hydrate, sodium antimonite and sodium sulph-antimonite are formed, and when sulphuric acid is added to the hot solution, these salts are decomposed, and antimonous sulphide and antimonous oxide are precipitated, whilst sodium sulphate remains in solution.

$$\underset{\text{Antimonous Sulphide.}}{Sb_2S_3} + \underset{\text{Sodium Hydrate.}}{6NaHO} = \underset{\text{Sodium Antimonite.}}{Na_3SbO_3} + \underset{\text{Sodium Sulph-Antimonite.}}{Na_3SbS_3} + \underset{\text{Water.}}{3H_2O},$$

and

$$\underset{\text{Sodium Antimonite.}}{2Na_3SbO_3} + \underset{\text{Sulphuric Acid.}}{3H_2SO_4} = \underset{\text{Sodium Sulphate.}}{3Na_2SO_4} + \underset{\text{Antimonous Oxide.}}{Sb_2O_3} + \underset{\text{Water.}}{3H_2O},$$

and

$$\underset{\text{Sodium Sulph-Antimonite.}}{2Na_3SbS_3} + \underset{\text{Sulphuric Acid.}}{3H_2SO_4} = \underset{\text{Sodium Sulphate.}}{3Na_2SO_4} + \underset{\text{Antimonous Sulphide.}}{Sb_2S_3} + \underset{\text{Hydrosulphuric Acid.}}{3H_2S}.$$

Antimonium Sulphuratum. *U.S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A reddish-brown, amorphous powder. The residue, after having been washed and dried, burns, on the application of a flame, with the characteristic odor of sulphur, and should leave not more than a scanty ash.	Odorless; tasteless.	Insoluble.	Insoluble.	When heated with 12 parts of hydrochloric acid it is nearly all dissolved with evolution of hydrosulphuric acid.

Tests for Identity.	Impurities.	Test for Impurities.
On dropping a solution of Sulphurated Antimony in hydrochloric acid into water, a white precipitate is produced, which, after washing and drying, should weigh not less than 85 per cent. of the sulphide. The liquid filtered from this precipitate yields an orange-red precipitate with hydrosulphuric acid.	Sulphate.	Distilled Water boiled with Sulphurated Antimony, filtered and acidulated with hydrochloric acid, should be rendered not more than slightly opalescent by test-solution of chloride of barium.

Uses.—Sulphurated antimony is alterative, emetic, and diaphoretic, in doses of one to five grains.

PILULÆ ANTIMONII COMPOSITÆ. *U.S.* Compound Pills of Antimony.

[Plummer's Pills.]

Each pill contains one-half grain of sulphurated antimony, one-half grain of mild chloride of mercury, one grain of guaiac, with sufficient mucilage of tragacanth to form a mass. This pill is used in secondary syphilis and in various skin diseases. (See Pilulæ.)

PULVIS ANTIMONIALIS. *U.S.* Antimonial Powder.

[James' Powder.]

This powder is made from thirty-three parts of oxide of antimony and sixty-seven parts of precipitated phosphate of calcium. It is used as a diaphoretic, in doses of three to five grains. (See Pulveres.)

VINUM ANTIMONII. *U.S.* Wine of Antimony.

Made by dissolving four parts of tartrate of antimony and potassium in sixty parts of boiling distilled water, and adding sufficient stronger white wine to make one thousand parts. It is used as an addition to diaphoretic and expectorant mixtures. The dose is ten to twenty minims.

Arsenic. As; 74.9.

Arsenic is found in many minerals, generally as a sulphide or arsenide. It may be easily obtained from arsenious oxide by heating it with charcoal. Arsenic is a brilliant, crystalline element, of a steel-gray color when freshly sublimed; upon exposure to the air its surface becomes blackish and dull. Its sp. gr. is about 5.73 to 5.88. It forms two combinations with oxygen, arsenious and arsenic oxides, As_2O_3 and As_2O_5 respectively, to each of which the corresponding acid is known, and three with sulphur, namely, the disulphide, or *realgar*, As_2S_2; the trisulphide, or *orpiment*, As_2S_3, corresponding in composition to arsenious oxide; and the pentasulphide, As_2S_5, corresponding to arsenic oxide.

Tests for Arsenic and its Salts.

1. Hydrosulphuric acid, when added to an acidulated solution of arsenious acid, produces a bright yellow precipitate (orpiment). This is soluble in water of ammonia and reprecipitated by acids.

2. If silver nitrate is added to a solution of arsenious acid, with a small quantity of water of ammonia, a yellow precipitate (silver arsenite) is produced. This precipitate is soluble in an excess of ammonia, and also in nitric acid.

3. If cupric sulphate is added to a solution of arsenious acid, with a small quantity of water of ammonia, a green precipitate (Scheele's green) is produced. This precipitate is soluble in an excess of ammonia.

4. If a liquid containing arsenic is added to a flask containing zinc and sulphuric acid, the hydrogen gas produced will upon ignition deposit a ring of metallic arsenic upon a cold surface (Marsh's test).

5. If a thin piece of bright copper plate be placed in an acidulated arsenical solution, and the latter be heated, a film of metallic arsenic will be deposited upon it (Reinsch's test).

Officinal Preparations of Arsenic.

Officinal Name.	Preparation.
Acidum Arseniosum	By roasting arsenical ores and resubliming the sublimate.
Liquor Acidi Arseniosi	1 part arsenious acid, 2 parts hydrochloric acid, distilled water to make 100 parts.
Liquor Potassii Arsenitis	1 part arsenious acid, 1 part potassium bicarbonate, 3 parts compound tincture of lavender, distilled water to make 100 parts.
Sodii Arsenias	By fusing arsenious acid with sodium nitrate and carbonate.
Liquor Sodii Arseniatis	By dissolving 1 part of sodium arseniate in 99 parts of distilled water.
Arsenii Iodidum	By fusing 1 part of arsenic and 5 parts of iodine together.
Liquor Arsenii et Hydrargyri Iodidi	By dissolving 1 part each of arsenic iodide and mercuric iodide in 100 parts of distilled water.

Unofficinal Compounds of Arsenic.

Arsenii Bisulphidum, As_2S_2, = 213.8. Bisulphide of Arsenic.	By fusing together 5 parts arsenious acid and 3 parts sulphur, then collecting the mass.

Unofficinal Compounds of Arsenic.—(*Continued.*)

Arsenii Bromidum, $AsBr_3$, = 314.3. Bromide of Arsenic.	By diffusing arsenic in powder in a retort filled with bromine vapor, then distilling the arsenic bromide from the excess of arsenic.
Arsenii Chloridum, $AsCl_3$, = 181.1. Chloride of Arsenic.	By direct combination of arsenic and chlorine.
Arsenii Trisulphidum, As_2S_3, = 245.8. Trisulphide of Arsenic.	By fusing 5 parts arsenious acid with 4 to 5 parts sulphur, then collecting the mass.

ACIDUM ARSENIOSUM. *U. S.* Arsenious Acid.

As_2O_3; 197.8. [ARSENIOUS OXIDE; WHITE ARSENIC.]

Preparation.—Arsenious acid, or, as it is commonly termed, arsenic, is made by roasting arsenical ores in reverberatory furnaces with long horizontal flues: the arsenious acid collects as a solid sublimate, which is afterwards resublimed in cast-iron vessels with conical heads. Chemically, it is not regarded as an acid, but is an oxide, As_2O_3, the true acid being formed when the oxide is dissolved in water.

$$\underset{\text{Arsenious Oxide.}}{2As_2O_3} + \underset{\text{Water.}}{6H_2O} = \underset{\text{Arsenious Acid.}}{4H_3AsO_3}.$$

Acidum Arseniosum. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A heavy, white solid, occurring either as an opaque powder, or in transparent or semi-transparent masses which usually have a striated appearance; permanent in the air. Heated to about 218° C. (424.4° F.), it is completely volatilized without melting, and, when thrown on ignited charcoal, it emits an alliaceous odor.	Odorless; tasteless; faintly acid reaction.	Cold. 30 to 80 parts. Boiling. 15 parts.	Cold. Sparingly. Boiling. Sparingly.	Freely by hydrochloric acid, the alkalies and their carbonates, moderately in glycerin.

Tests for Identity.	Quantitative Test.
An aqueous solution of the acid affords a lemon-yellow precipitate with test-solution of ammonio-nitrate of silver, and a grass-green one with test-solution of ammonio-sulphate of copper; and, if the solution is acidulated with hydrochloric acid, a bright yellow one with hydrosulphuric acid. This latter precipitate is soluble in test-solution of carbonate of ammonium and insoluble in diluted hydrochloric acid (distinction from sulphides of antimony and tin).	If 0.247 Gm. of the acid be dissolved, with 2 Gm. of bicarbonate of sodium, in boiling water, the solution should decolorize not less than 48.5 C.c. of the volumetric solution of iodine (corresponding to at least 97 per cent. of pure arsenious acid).

Uses.—Arsenious acid is used as an alterative, in doses of one-twentieth of a grain; externally, it is employed as an escharotic, and, mixed with various substances in the form of a paste, is often applied to cancers and ulcers. Two antidotes to arsenical poisoning are officinal (see pages 574, 575).

LIQUOR ACIDI ARSENIOSI. *U. S.* Solution of Arsenious Acid.

[LIQUOR ARSENICI CHLORIDI, Pharm. 1870.]

	By measure.
Arsenious Acid, in small pieces, 1 part, or	37 grains.
Hydrochloric Acid, 2 parts, or	67 minims.
Distilled Water, a sufficient quantity,	
To make 100 parts, or	8 fl. oz.

Boil the Arsenious Acid with the Hydrochloric Acid and with *twenty-five parts* [or 2 fl. oz.] of Distilled Water, until it is dissolved. Filter the liquid, and pass enough Distilled Water through the filter to make the solution weigh *one hundred parts* [or measure 8 fl. oz.].

This is simply a solution of arsenious acid in diluted hydrochloric acid, no chemical action taking place. The officinal quantitative test is as follows:

If 24.7 Gm. of Solution of Arsenious Acid be boiled for a few minutes with 2 Gm. of bicarbonate of sodium, the resulting liquid should not decolorize less than 48.5 C.c. of the volumetric solution of iodine (corresponding to 1 per cent. of arsenious acid of the required purity).

Uses.—This solution is used as an alterative, in doses of two to five minims.

LIQUOR POTASSII ARSENITIS. *U. S.* Solution of Arsenite of Potassium.

[FOWLER'S SOLUTION.]

	By measure.
Arsenious Acid, in small pieces, 1 part, or	37 grains.
Bicarbonate of Potassium, 1 part, or	37 grains.
Compound Tincture of Lavender, 3 parts, or	2 fl. dr.
Distilled Water, a sufficient quantity,	
To make 100 parts, or	8 fl. oz.

Boil the Arsenious Acid and Bicarbonate of Potassium in a glass vessel with *ten parts* [or 6 fl. dr.] of Distilled Water, until the Acid is completely dissolved. Then add the Compound Tincture of Lavender, and enough Distilled Water to make the product weigh *one hundred parts* [or measure 8 fl. oz.]. Lastly, set the mixture aside for eight days, and then filter through paper.

$$\underset{\text{Acid Potassium Carbonate.}}{2KHCO_3} + \underset{\text{Arsenious Oxide.}}{As_2O_3} + \underset{\text{Water.}}{H_2O} = \underset{\text{Potassium Arsenite.}}{2KH_2AsO_3} + \underset{\text{Carbon Dioxide.}}{2CO_2}$$

When arsenious oxide is boiled with acid potassium carbonate in concentrated solution, carbon dioxide is evolved, and potassium arsenite is produced; but, owing to the fact that the salts are soluble in the quantity of water directed in the formula, a solution can be effected without involving any chemical change. The corresponding British solution (Liquor Arsenicalis) is made from dilute solutions, and its title does not indicate any chemical action. The officinal quantitative test is as follows:

If 24.7 Gm. of the Solution be boiled with 2 Gm. of bicarbonate of sodium, the liquid, when cold, diluted with 100 C.c. of water, and some gelatinized starch added, should require from 48.5 to 50 C.c. of

the volumetric solution of iodine, before the blue color ceases to disappear on stirring (corresponding to 1 per cent. of arsenious acid of the required purity).

Uses.—Solution of arsenite of potassium is largely used as an alterative, in doses of three to five minims.

SODII ARSENIAS. *U.S.* Arseniate of Sodium.

$Na_2HAsO_4.7H_2O$; 311.9.

For an account of the preparation and uses of this salt, see page 474.

LIQUOR SODII ARSENIATIS. *U.S.* Solution of Arseniate of Sodium.

Made by dissolving one part of sodium arseniate in ninety-nine parts of distilled water (see page 474).

ARSENII IODIDUM. *U.S.* Iodide of Arsenic.

AsI_3; 454.7. [ARSENICI IODIDUM, Pharm. 1870.]

Preparation.—In the former officinal process this iodide was made by a direct combination of the elements.

Take of Arsenic, 60 grains; Iodine, 300 grains. Rub the Arsenic in a mortar until reduced to a fine powder; then add the Iodine, and rub them together until they are thoroughly mixed. Put the mixture into a small flask or a test-tube, loosely stopped, and heat it very gently until liquefaction occurs. Then incline the vessel in different directions, in order that any portion of the iodine, which may have condensed on its surface, may be returned into the melted mass. Lastly, pour the melted iodide on a porcelain slab, and, when it is cold, break it into pieces, and keep it in a well-stopped bottle.

By this process it is difficult to secure entire combination, and it has been made by dissolving the iodine in carbon disulphide, and gradually adding the finely-powdered metallic arsenic until the purple color, showing the presence of free iodine, has disappeared; the solution is then evaporated and crystallized.

Arsenii Iodidum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Glossy, orange-red, crystalline masses, or shining, orange-red, crystalline scales, gradually losing iodine when exposed to the air. By heat the salt is completely volatilized.	Iodine-like odor; iodine-like taste; neutral reaction.	Cold. 3.5 parts. Gradually decomposed.	Cold. 10 parts. Gradually decomposed.	Soluble in ether and disulphide of carbon.

Tests for Identity.

The aqueous solution has a yellow color, and, on standing, gradually decomposes into arsenious and hydriodic acids. On passing hydrosulphuric acid through the solution, a lemon-yellow precipitate is thrown down. If the salt be heated with diluted nitric acid, vapor of iodine will be given off.

Uses.—The principal use of this compound is in making solution of iodide of arsenic and mercury. The dose is one-sixteenth of a grain as an alterative.

LIQUOR ARSENII ET HYDRARGYRI IODIDI. *U. S.* Solution of Iodide of Arsenic and Mercury.

[LIQUOR ARSENICI ET HYDRARGYRI IODIDI, Pharm. 1870. DONOVAN'S SOLUTION.]

	By measure.
Iodide of Arsenic, 1 part, or	35 grains.
Red Iodide of Mercury, 1 part, or	35 grains.
Distilled Water, a sufficient quantity,	
To make 100 parts, or	8 fl. oz.

Triturate the Iodides with *fifteen parts* [or 1 fl. oz.] of Distilled Water, until they are dissolved. Filter the liquid, and pass enough Distilled Water through the filter to make the solution weigh *one hundred parts* [or measure 8 fl. oz.].

This solution, in which no chemical change occurs, should be of a light straw color; when darker than this, free iodine is probably present, and if a globule of mercury and a few grains of metallic arsenic are dropped into the bottle containing the solution, and the whole well agitated and filtered, the proper color may be restored.

Uses.—Solution of iodide of arsenic and mercury is used as an alterative. The dose is from three to five minims, largely diluted.

Bismuth. Bi; 210.

Bismuth is found in the metallic state, and occasionally as a sulphide. It is a crystalline, brittle, pulverizable, brilliant metal, having a silver color with a reddish tint. Its sp. gr. is 9.8. It closely resembles metallic antimony in appearance.

Tests for Salts of Bismuth.

1. Hydrosulphuric acid or ammonium sulphide produces in solutions of bismuth salts a black precipitate of sulphide, insoluble in excess.
2. When acid solutions of bismuth salts are poured into water, white precipitates (subsalts) are produced.

Officinal Preparations of Bismuth.

Officinal Name.	Preparation.
Bismuthi Citras	By boiling bismuth subnitrate with citric acid and water, and adding distilled water to the clear solution.
Bismuthi et Ammonii Citras	By dissolving bismuth citrate in water of ammonia, evaporating the solution, and scaling.
Bismuthi Subcarbonas	By dissolving bismuth in nitric acid, purifying, and precipitating by adding solution of sodium carbonate.
Bismuthi Subnitras	By dissolving bismuth in nitric acid, purifying, and adding the solution in nitric acid to water.

Unofficinal Preparations of Bismuth.

Bismuthi Bromidum, $BiBr_3$, = 450. Bromide of Bismuth.	By treating bismuth with excess of bromine and collecting the steel-gray mass.
Bismuthi Chromas, $3Bi_2O_3.2CrO_3$, = 1604.8. Chromate of Bismuth.	By adding a solution of bismuth nitrate to a moderately concentrated solution of acid potassium chromate in slight excess, and collecting the precipitate.
Bismuthi Lactas. Lactate of Bismuth.	By boiling 10 p. bismuth subnitrate with excess of soda, washing the oxide well with water, then mixing with 9 p. lactic acid, digesting the mixture, and drying in a water-bath.

Unofficinal Preparations of Bismuth.—(*Continued.*)

Bismuthi Oxalas, $C_6Bi_2O_{13}.15H_2O$, = 954. Oxalate of Bismuth.	By mixing bismuth nitrate with a solution of oxalic acid, and collecting the precipitate.
Bismuthi Oxidum, Bi_2O_3, = 468. Oxide of Bismuth.	By mixing 4 oz. bismuth subnitrate and 1 pint solution of soda, then boiling for 5 minutes, decanting the liquid, and washing the precipitate with distilled water.
Bismuthi Oxychloridum, BiOCl, = 261.4. Oxychloride of Bismuth.	By pouring slowly a solution of bismuth in nitric acid into a solution of sodium chloride, and collecting the precipitate.
Bismuthi Phosphas, $BiPO_4$, = 305. Phosphate of Bismuth.	By adding bismuth nitrate to a solution of phosphoric acid containing nitric acid, and collecting the precipitate.
Bismuthi Salicylas. Salicylate of Bismuth.	By dissolving bismuth nitrate in glycerin and adding a concentrated solution of sodium salicylate, then collecting the precipitate.
Bismuthi Tannas. Tannate of Bismuth.	By dissolving 22 p. bismuth nitrate in the least amount of nitric acid, previously diluted with half its weight of water, pouring the solution into an excess of solution of soda, washing the precipitate with water, then triturating the precipitate with 10 p. tannin diluted with water, straining and drying.
Bismuthi Tartras. Tartrate of Bismuth.	By adding a hot, concentrated solution of 4 p. tartaric acid to a hot, moderately strong solution of 5 p. bismuth oxide in nitric acid, then washing the precipitate with an aqueous solution of tartaric acid.
Bismuthi Valerianas. Valerianate of Bismuth.	By dissolving bismuth nitrate in the smallest amount of nitric acid, previously diluted with half its weight of water, then adding a concentrated solution of sodium valerianate, washing the precipitate with water mixed with valerianic acid; lastly, drying the precipitate.

BISMUTHI CITRAS. *U.S.* Citrate of Bismuth.

$BiC_6H_5O_7$; 399.

Subnitrate of Bismuth, 10 parts, or	1 oz. av.
Citric Acid, 7 parts, or	306 grains.
Distilled Water, a sufficient quantity.	

Boil the Subnitrate of Bismuth and the Citric Acid with *forty parts* [or 4 fl. oz.] of Distilled Water, until a drop of the mixture yields a clear solution with water of ammonia. Then add *five hundred parts* [or 3 pints] of Distilled Water, allow the suspended matter to deposit, wash the precipitate (first by decantation, and afterwards on a strainer), with Distilled Water, until the washings are tasteless, and dry the residue at a gentle heat.

In this process the bismuth salt is decomposed by the boiling solution of citric acid.

$$\underset{\text{Bismuth Subnitrate.}}{BiONO_3.H_2O} + \underset{\text{Citric Acid.}}{H_3C_6H_5O_7} = \underset{\text{Bismuth Citrate.}}{BiC_6H_5O_7} + \underset{\text{Nitric Acid.}}{HNO_3} + \underset{\text{Water.}}{2H_2O}.$$

Bismuthi Citras. *U.S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A white, amorphous powder, permanent in the air.	Odorless; tasteless.	Insoluble.	Insoluble.	Soluble in water of ammonia.

Tests for Identity.	Impurities.	Test for Impurities.
When strongly heated, the salt chars, and, on ignition, leaves a more or less blackened residue with a yellow surface, which is dissolved by warm nitric acid. This solution, on being dropped into water, occasions a white turbidity. The ammoniacal solution, when treated with hydrosulphuric acid in excess, yields a black precipitate. The filtrate, deprived, by heat, of the excess of hydrosulphuric acid and cooled, when boiled with lime-water, produces a white precipitate.	Nitrate.	When a portion of the filtrate obtained by treating the ammoniacal solution with hydrosulphuric acid in excess is deprived of the excess of hydrosulphuric acid by heating, and is mixed with an equal volume of concentrated sulphuric acid and cooled, a brown or brownish-black zone should not appear around a crystal of ferrous sulphate dropped into the liquid.

Uses.—This salt may be used for the same purposes as the subnitrate. It was made officinal because it is used in making the soluble double salt of citrate of bismuth and ammonium.

BISMUTHI ET AMMONII CITRAS. *U.S.* Citrate of Bismuth and Ammonium.

Citrate of Bismuth, 10 parts, or . . . . . 1 oz. av.
Water of Ammonia,
Distilled Water, each, a sufficient quantity.

Mix the Citrate of Bismuth with *twenty parts* [or 2 fl. oz.] of Distilled Water to a smooth paste, and gradually add Water of Ammonia until the salt is dissolved, and the liquid has a neutral or only faintly alkaline reaction. Then filter the solution, evaporate it to a syrupy consistence, and spread it on plates of glass, so that, on drying, the salt may be obtained in scales. Keep the product in small, well-stopped vials, protected from light.

This is the only soluble salt of bismuth officinal. If its aqueous solution is not perfectly transparent, it is probably due to the loss of ammonia on keeping the salt: a drop or two of water of ammonia added to the cloudy solution will generally make it transparent.

Liquor Bismuthi.—An aqueous solution of citrate of bismuth has been largely used in England. It may be made by dissolving 260 grains of citrate of bismuth and ammonium in 14 fl. oz. of distilled water, neutralizing the solution with water of ammonia, and adding 2 fl. oz. of alcohol.

Bismuthi et Ammonii Citras. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Small, shining, pearly or translucent scales, becoming opaque on exposure to air. When strongly heated, the salt melts, then chars, and finally leaves a more or less blackened residue with a yellow surface, which is dissolved by warm nitric acid. This solution, on being dropped into water, occasions a white turbidity.	Odorless; slightly acidulous and metallic taste; neutral or faintly alkaline reaction.	Very soluble.	Sparingly soluble.

Tests for Identity.	Impurities.	Test for Impurities.
The aqueous solution of the salt, when boiled with solution of potassa, evolves vapor of ammonia; and, when treated with hydrosulphuric acid, yields a black precipitate. If the filtrate be deprived, by heat, of the excess of hydrosulphuric acid and cooled, a portion of it, boiled with lime-water, produces a white precipitate.	Nitrate	When a portion of the filtrate, obtained by treating an aqueous solution of the salt with hydrosulphuric acid, is deprived of the excess of acid by heating, and is mixed with an equal volume of concentrated sulphuric acid and cooled, there should not be produced a brown or brownish-black zone around a crystal of ferrous sulphate when dropped into the liquid.

Uses.—This salt is astringent, and is generally prescribed in solution. The dose is from one to three grains.

BISMUTHI SUBCARBONAS. *U.S.* Subcarbonate of Bismuth.

$(BiO)_2CO_3.H_2O$; 530.

Preparation.—Subcarbonate of bismuth may be made by the former officinal process, as follows:

Take of Bismuth, in pieces, 2 oz. troy; Nitric Acid 8½ oz. troy; Water of Ammonia 5 fl. oz.; Carbonate of Sodium 10 oz. troy; Distilled Water a sufficient quantity. Mix 4½ oz. troy of the Nitric Acid with 4 fl. oz. of Distilled Water in a capacious glass vessel, and, having added the Bismuth, set the whole aside for twenty-four hours. Dilute the resulting solution with 10 fl. oz. of Distilled Water, stir it thoroughly, and, after twenty-four hours, filter through paper. To the filtered liquid, previously diluted with 4 pints of Distilled Water, slowly add the Water of Ammonia, constantly stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with 2 pints of Distilled Water, and drain it again. Then place the precipitate in a proper vessel, add the remainder of the Nitric Acid, and afterwards 4 fl. oz. of Distilled Water, and set the solution aside. At the end of twenty-four hours, filter through paper. Dissolve the Carbonate of Sodium in 12 fl. oz. of Distilled Water, with the aid of heat, and filter the solution through paper. To this, when cold, slowly add the solution of nitrate of bismuth, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with Distilled Water until the washings pass tasteless. Lastly, press, dry it on bibulous paper with a gentle heat, and rub it into powder.

As metallic bismuth generally contains arsenic, it is very important to provide that this should be left behind, in the processes for making its medicinal preparations. It is on this account that the above formula is so elaborate. The bismuth is first dissolved in nitric acid, a portion of which oxidizes the metal, with the evolution of nitrous vapors, while another portion combines with the oxide produced to form bismuth nitrate. At the same time the arsenic is also oxidized at the expense of the nitric acid, and unites with a portion of the oxidized metal so as to produce bismuth arseniate. Both of these salts, therefore, are contained in the solution, which is very concentrated. Both

have the property, when their solution is diluted with water, of separating into two salts, one an insoluble subsalt which is deposited, and the other a soluble acid salt which is held in solution. But the arseniate is more disposed to the change than the nitrate, and requires for the purpose a smaller amount of water of dilution. The subarseniate is slowly deposited in twenty-four hours, and is then separated by filtration. The addition of a large quantity of distilled water precipitates the bismuth subnitrate, the ammonia being added to separate it more thoroughly by combining with the nitric acid. The precipitate, thus freed from arsenic, is now redissolved in nitric acid partially diluted and added to solution of sodium carbonate; by double decomposition, bismuth subcarbonate and sodium nitrate are thus produced.

Bismuthi Subcarbonas. *U. S.*	Odor and Taste.	Solubility.	
		Water.	Alcohol.
A white or pale yellowish-white powder, permanent in the air. When heated to redness, the salt loses moisture and carbonic acid gas, and leaves a yellow residue which is soluble in nitric or in hydrochloric acid, and which is blackened by hydrosulphuric acid.	Odorless; tasteless.	Insoluble.	Insoluble.

Impurities.	Tests for Impurities.
Insoluble Foreign Salts.	On dissolving 1 part of the salt in 6 parts of warm nitric acid (sp. gr. 1.200), a copious effervescence takes place, and no residue should be left.
Lead.	On pouring a solution of 1 part of the salt in 6 parts of warm nitric acid (sp. gr. 1.200) into 50 parts of water, a white precipitate is produced, and, on filtering and concentrating the filtrate to 6 parts, a portion of this, mixed with 5 times its volume of diluted sulphuric acid, should not become cloudy.
Copper.	If a solution of 1 part of the salt in 6 parts of warm nitric acid (sp. gr. 1.200) be precipitated with an excess of water of ammonia, the supernatant liquid should not exhibit a blue tint.
Chloride.	On diluting a solution of 1 part of the salt in 6 parts of warm nitric acid (sp. gr. 1.200) with 5 volumes of distilled water, the filtrate should not be affected by test-solution of nitrate of silver.
Sulphate.	Nor by test-solution of nitrate of barium.
Silver.	Nor by hydrochloric acid.
Alkalies and Alkaline Earths.	If the salt be boiled with acetic acid diluted with an equal volume of water, and the cold filtrate freed from bismuth by hydrosulphuric acid, the new filtrate should leave no fixed residue on evaporation.
Traces of Ammonia.	On boiling 1 Gm. of the salt with 10 C.c. of solution of soda (sp. gr. 1.260), and holding a glass rod dipped in acetic acid over the test-tube, not more than a faint, white cloud, but no heavy, white fumes, should appear.
Traces of Antimony, Arsenic, and Tin.	If the mixture of 1 Gm. of the salt with 10 C.c. of solution of soda (sp. gr. 1.260), after thorough boiling, be diluted with water to 50 C.c. and filtered, the filtrate, when supersaturated with hydrochloric acid, and treated with hydrosulphuric acid, should not deposit more than a trace of a precipitate, which should not have a yellow or orange color.
More than traces of Arsenic.	On boiling 1 Gm. of the salt with 10 C.c. of strong solution of soda, decanting the liquid from the precipitated oxide of bismuth into a long test-tube, and adding about 0.5 Gm. of aluminium wire cut into small pieces (a loose plug of cotton being pushed a short distance down the tube), the generated gas should not impart any color or tint to paper wet with test-solution of nitrate of silver and kept over the mouth of the test-tube for half an hour.

Uses.—This bismuth compound is astringent and tonic. It is employed for the same purposes as the subnitrate: the latter is much more frequently used. The dose is five to ten grains.

BISMUTHI SUBNITRAS. *U. S.* **Subnitrate of Bismuth.**

$BiONO_3.H_2O$; 306.

Preparation.—This important salt may be made by the former officinal process, as follows:

Take of Bismuth, in pieces, 2 oz. troy; Nitric Acid 8½ oz. troy; Carbonate of Sodium 10 oz. troy; Water of Ammonia 5 fl. oz.; Distilled Water a sufficient quantity. Mix 4½ oz. troy of the Nitric Acid with 4 fl. oz. of Distilled Water, in a capacious glass vessel, and, having added the Bismuth, set the whole aside for twenty-four hours. Dilute the resulting solution with 10 fl. oz. of Distilled Water, stir it thoroughly, and, after twenty-four hours, filter through paper. Dissolve the Carbonate of Sodium in 20 fl. oz. of Distilled Water with the aid of heat, and filter the solution through paper. To this, when cold, slowly add the solution of nitrate of bismuth, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with Distilled Water until the washings pass tasteless, and drain again as completely as possible. Then place the moist precipitate in a capacious vessel, gradually add the remainder of the Nitric Acid, and afterwards 4 fl. oz. of Distilled Water, and set the solution aside. At the end of twenty-four hours, filter through paper, and to the filtered liquid, previously diluted with 4 pints of Distilled Water, slowly add the Water of Ammonia, with constant stirring. Transfer the whole to a strainer, and, after the precipitate has been drained, wash it with 2 pints of Distilled Water, drain it again, and press out as much of the liquid as possible. Lastly, dry it upon bibulous paper with a gentle heat, and rub it into powder.

The separation of the arsenic is accomplished by first preparing the carbonate, by adding the acid solution of bismuth to a solution of sodium carbonate in excess, whereby most of the arsenic is retained in the solution, probably as sodium arseniate, while the insoluble carbonate is precipitated. This is dissolved, with the aid of heat, in nitric acid, so as to make a very concentrated solution of the nitrate, to which, when cold, just so much water is added as to begin to produce a permanent turbidness. The object of this is to allow any arsenic that may be still present to be deposited, which happens for reasons stated in explaining the process for procuring the subcarbonate (see page 631). The deposited matter having been precipitated, only the pure nitrate remains in solution, which is made to yield the subnitrate by large dilution with water, and still more completely by the addition of ammonia.

$$\underset{\text{Bismuth.}}{Bi_2} + \underset{\text{Nitric Acid.}}{8HNO_3} = \underset{\text{Bismuth Nitrate.}}{(Bi3NO_3)_2} + \underset{\text{Water.}}{4H_2O} + \underset{\text{Nitrogen Monoxide.}}{2NO};$$

then

$$\underset{\substack{\text{Bismuth}\\\text{Nitrate.}}}{5(Bi3NO_3)} + \underset{\text{Water.}}{8H_2O} = \underset{\text{Bismuth Subnitrate.}}{4BiONO_3H_2O} + \underset{\substack{\text{Bismuth}\\\text{Nitrate.}}}{Bi3NO_3} + \underset{\substack{\text{Nitric}\\\text{Acid.}}}{8HNO_3}.$$

Bismuthi Subnitras. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A heavy white powder, permanent in the air.	Odorless; almost tasteless; slightly acid reaction.	Insoluble.	Insoluble.

Test for Identity.	Impurities.	Tests for Impurities.
When heated to redness, the salt gives off moisture, and afterwards nitrous vapors, leaving a yellow residue which is soluble in nitric or in hydrochloric acid, and which is blackened by hydrosulphuric acid.	Carbonate.	On dissolving 1 part of the salt in 5 parts of warm nitric acid (sp. gr. 1.200), no effervescence should occur.
	Insoluble Foreign Salts.	No residue should be left by treating 1 part of the salt with 5 parts of nitric acid (sp. gr. 1.200).
		See Bismuthi Subcarbonas.

Uses.—Subnitrate of bismuth is largely used in intestinal disorders: it is astringent, tonic, and sedative. The dose is from three to ten grains.

CHAPTER XLVIII.

GOLD AND PLATINUM.

Au; 196.2. Pt; 194.4.

SALTS of these precious metals are officinal,—the gold salt as a substance in the materia medica, the platinum salt as a test-liquid: both are chlorides. Gold and platinum are both found native in the free state.

Tests for Gold Salts.

1. If hydrosulphuric acid be added to the solution of a gold salt, a dark brown, almost black, precipitate (auric sulphide) is produced, which is soluble in ammonium sulphide.
2. If ferrous sulphate be added to a solution of a gold salt, metallic gold in the form of a fine precipitate is produced: this may be fused into a button of gold by the use of the blow-pipe.
3. Stannous chloride if added to dilute solutions of gold salts produces a purple precipitate (purple of Cassius).

Tests for Platinum Salts.

1. If hydrosulphuric acid or ammonium sulphide be added to a solution of platinic chloride, a brown precipitate of platinic sulphide is produced, soluble in excess of ammonium sulphide.
2. If a solution of potassium chloride be added to a solution of platinic chloride acidulated with hydrochloric acid, a yellow precipitate (double chloride) is formed.

Officinal Salts of Gold and Platinum.

Officinal Name.	Preparation.
Auri et Sodii Chloridum . .	Equal parts of dry auric chloride and sodium chloride.
Platini Chloridum	Test-solution of platinic chloride, 1 part of platinic chloride in 20 parts of distilled water.

Unofficinal Preparations of Gold.

Auri Bromidum, $AuBr_3$, = 436.2. Bromide of Gold.	By dissolving gold in a mixture of nitric and hydrobromic acids, concentrating, then crystallizing.
Auri Chloridum, $AuCl_3$, = 106.2. Chloride of Gold.	By dissolving gold in nitrohydrochloric acid, concentrating carefully, then crystallizing.
Auri Iodidum, AuI_3, = 576. Iodide of Gold.	By gradually adding a neutral solution of auric chloride to a solution of potassium iodide, collecting and drying the precipitate.

AURI ET SODII CHLORIDUM. *U.S.* Chloride of Gold and Sodium.

A mixture composed of equal parts of dry Chloride of Gold [$AuCl_3$; 302.4] and Chloride of Sodium [NaCl; 58.4].

Preparation.—It may be made by dissolving gold in nitrohydrochloric acid, evaporating the solution to dryness, weighing, and dissolving the dry mass in eight times its weight of distilled water. To this solution a weight of pure decrepitated common salt equalling that of the dry chloride of gold is added, previously dissolved in four parts of water. The mixed solution is then evaporated to dryness, being constantly stirred with a glass rod.

Auri et Sodii Chloridum. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
An orange-yellow powder, slightly deliquescent in damp air. When exposed to a red heat, it is decomposed and metallic gold is separated. A fragment of the compound imparts an intense, persistent yellow color to a non-luminous flame. Its aqueous solution yields, with test-solution of nitrate of silver, a white precipitate insoluble in nitric acid, but soluble in ammonia.	Odorless; saline, metallic taste; slightly acid reaction.	Very soluble.	At least one-half should be soluble.

Quantitative Test.	Impurities.	Test for Impurities.
If 0.5 Gm. of Chloride of Gold and Sodium be dissolved in 20 C.c. of water, and treated with a clear solution of 2 Gm. of ferrous sulphate in 20 C.c. of water acidulated with a few drops of sulphuric acid, a brown precipitate of metallic gold will be thrown down. If, after at least two hours, this precipitate be separated, well washed, dried, and ignited, the residue of metallic gold should weigh not less than 0.162 Gm. (corresponding to 32.4 per cent. of metallic gold).	Free Acid.	On bringing a glass rod dipped into water of ammonia close to a portion of the compound, no white fumes should make their appearance.

Uses.—This salt is used internally as an alterative. The dose is from one-twelfth to one-fourth of a grain.

Officinal Chemical Substances, with their Preparations.

Officinal Name.	Chemical Composition.	Uses and Dose.	Officinal Preparations in heavy type; those in which the Substance is used in Roman type.
Acidum Aceticum.	$HC_2H_3O_2$.	Rubefacient.	**Diluted Acetic Acid,** Extract of Colchicum Root.
Acidum Aceticum Dilutum.		Refrigerant; m. x.	Vinegars, Ammoniac Plaster, Ammoniac Plaster with Mercury, Solution of Acetate of Ammonium, Mixture of Acetate of Iron and Ammonium, Syrup of Garlic.
Acidum Aceticum Glaciale.	$HC_2H_3O_2$.	Solvent.	Solution of Acetate of Iron.
Acidum Arseniosum.	As_2O_3.	Alterative; gr. $\frac{1}{10}$.	**Solution** (with HCl), Solution of Arsenite of Potassium.
Acidum Benzoicum.	$HC_7H_5O_2$.	Stimulant; gr. x.	Camphorated Tincture of Opium.
Acidum Boricum.	H_3BO_3.	Antiseptic; gr. v.	
Acidum Carbolicum.	C_6H_5HO.	Irritant.	**Ointment.**
Acidum Carbolicum Crudum.		Disinfectant.	
Acidum Chromicum.	CrO_3.	Escharotic.	
Acidum Citricum.	$H_3C_6H_5O_7$, H_2O.	Refrigerant; gr. v–xxx.	**Syrup,** Citrate of Bismuth, Citrate of Iron and Strychnine, Solution of Citrate of Iron, Solution of Citrate of Iron and Quinine, Solution of Citrate of Magnesium, Solution of Citrate of Potassium, Granulated Citrate of Magnesium, Syrup of Hypophosphites.
Acidum Gallicum.	$HC_7H_5O_5$. H_2O.	Astringent; gr. v–xv.	**Ointment.**
Acidum Hydrobromicum Dilutum.	HBr.	Hypnotic; f℥ii.	
Acidum Hydrochloricum.	HCl.	Tonic, refrigerant; m. v–x.	**Diluted Hydrochloric Acid, Nitrohydrochloric Acid, Diluted Nitrohydrochloric Acid,** Chlorine Water, Chloride of Iron, Moulded Nitrate of Silver, Purified Animal Charcoal, Solution of Arsenious Acid, Solution of Chloride of Iron, Solution of Pepsin, Solution of Chloride of Zinc, Resin of Podophyllum, Precipitated Sulphur, Syrup of Lactophosphate of Calcium.
Acidum Hydrochloricum Dilutum.		Tonic, refrigerant; m. xv–xxx.	Abstract of Conium, Alcoholic Extract of Conium, Fluid Extract of Conium, Fluid Extract of Ergot, Tincture of Conium.
Acidum Hydrocyanicum Dilutum.	HCN.	Sedative, anodyne; m. ij.	
Acidum Lacticum.	$HC_3H_5O_3$.	Solvent.	Syrup of Lactophosphate of Calcium.

Officinal Name.	Chemical Composition.	Uses and Dose.	Officinal Preparations in heavy type; those in which the Substance is used in Roman type.
Acidum Nitricum.	HNO_3.	Tonic, antiseptic; m. v.	**Diluted Nitric Acid, Nitrohydrochloric Acid, Diluted Nitrohydrochloric Acid,** Chloride of Iron, Ointment of Nitrate of Mercury, Pyroxylin, Phosphoric Acid, Spirit of Nitrous Ether, Solution of Chloride of Iron, Solution of Nitrate of Iron, Solution of Subsulphate of Iron, Solution of Tersulphate of Iron, Solution of Nitrate of Mercury, Solution of Chloride of Zinc, Yellow Subsulphate of Mercury.
Acidum Nitricum Dilutum.		Tonic, antiseptic; m. xx.	
Acidum Nitrohydrochloricum.		Cholagogue; m. iij.	
Acidum Nitrohydrochloricum Dilutum.		Cholagogue; m. x.	
Acidum Oleicum.	$HC_{18}H_{33}O_2$.	Vehicle, externally.	Oleate of Mercury, Oleate of Veratrine.
Acidum Phosphoricum.	H_3PO_4.	Tonic, refrigerant; m. v.	**Diluted Phosphoric Acid,** Syrup of the Phosphates of Iron, Quinine, and Strychnine.
Acidum Phosphoricum Dilutum.		Tonic, refrigerant; m. xx.	
Acidum Salicylicum.	$HC_7H_5O_3$.	Antirheumatic; gr. x.	
Acidum Sulphuricum.	H_2SO_4.	Tonic, refrigerant; m. i.	**Diluted Sulphuric Acid,** Aromatic Sulphuric Acid, Ammoniated Glycyrrhizin, Diluted Hydrocyanic Acid, Ethereal Oil, Purified Chloroform, Precipitated Sulphate of Iron, Pyroxylin, Spirit of Nitrous Ether, Solution of Subsulphate of Iron, Solution of Tersulphate of Iron, Sulphurous Acid, Yellow Subsulphate of Mercury.
Acidum Sulphuricum Aromaticum.		Tonic, astringent; m. x.	Infusion of Cinchona.
Acidum Sulphuricum Dilutum.		Tonic, refrigerant; m. x.	Sulphurated Antimony.
Acidum Sulphurosum.	SO_2.	Antiferment; m. iij.	
Acidum Tannicum.	$C_{14}H_{10}O_9$.	Astringent; gr. iij.	**Ointment, Troches,** Styptic Collodion.
Acidum Tartaricum.	$H_2C_4H_4O_6$.	Refrigerant; gr. x.	Abstract of Aconite, Extract of Aconite, Compound Effervescing Powder, Fluid Extract of Aconite, Tartrate of Iron and Ammonium, Tincture of Aconite.
Æther.	$(C_2H_5)_2O$.	Anæsthetic, m. xxx.	Deodorized Tincture of Opium, Fluid Extract of Lactucarium, Mercury with Chalk.
Æther Aceticus.	$C_2H_5C_2H_3O_2$.	Stimulant, antispasmodic; m. xv.	Perfumed Spirit, Tincture of Acetate of Iron.
Æther Fortior.	$(C_2H_5)_2O$.	Anæsthetic; m. xxx.	**Spirit, Compound Spirit,** Denarcotized Opium, Collodion, Ethereal Oil, Phosphorated Oil, Oleoresins, Pills of Iodide of Iron, Pills of Phosphorus, Pyroxylin, Styptic Collodion.
Alcohol.	$C_2H_5(HO)$.		Tinctures, Fluid Extracts, etc.
Alcohol Dilutum.			Tinctures, Fluid Extracts, etc.

Officinal Name.	Chemical Composition.	Uses and Dose.	Officinal Preparations in heavy type; those in which the Substance is used in Roman type.
Alumen.	$K_2Al_2(SO_4)_4$. $24H_2O$.	Astringent, emetic; gr. v–xxx.	**Dried Alum**, Hydrate of Aluminium.
Alumen Exsiccatum.	$K_2Al_2(SO_4)_4$.	Astringent, escharotic; gr. iij.	
Aluminii Hydras.	$Al_2(HO)_6$.	Astringent; gr. v.	
Aluminii Sulphas.	$Al_2(SO_4)_3$. $18H_2O$.	Astringent; gr. v.	
Ammonii Benzoas.	$NH_4C_7H_5O_2$.	Stimulant; gr. v.	
Ammonii Bromidum.	NH_4Br.	Nervine; gr. x.	
Ammonii Carbonas.	NH_4HCO_3. $NH_4NH_2CO_2$.	Stimulant, irritant; gr. v.	Aromatic Spirit of Ammonia, Tartrate of Iron and Ammonium, Solution of Acetate of Ammonium.
Ammonii Chloridum.	NH_4Cl.	Expectorant; gr. x.	**Troches.**
Ammonii Iodidum.	NH_4I.	Resolvent; gr. iij.	
Ammonii Nitras.	NH_4NO_3.	In making Nitrous Oxide.	
Ammonii Phosphas.	$(NH_4)_2HPO_4$.	Antirheumatic; gr. xx.	
Ammonii Sulphas.	$(NH_4)_2SO_4$.		
Ammonii Valerianas.	$NH_4C_5H_9O_2$.	Nervine; gr. v.	
Amyl Nitris.	$C_5H_{11}NO_2$.	Anæsthetic; m. iij.	
Antimonii et Potassii Tartras.	$2KSbOC_4H_4O_6$. H_2O.	Expectorant; gr. $\frac{1}{10}$–$\frac{1}{4}$. Emetic; gr. i.	Compound Syrup of Squill, Wine of Antimony.
Antimonii Oxidum.	Sb_2O_3.	Alterative, sedative; gr. iij.	Antimonial Powder.
Antimonii Sulphidum.	Sb_2S_3.	Alterative; gr. iij.	**Purified Sulphide of Antimony** (with Water of Ammonia).
Antimonii Sulphidum Purificatum.		Alterative; gr. iij.	Sulphurated Antimony.
Antimonium Sulphuratum.		Alterative, diaphoretic; gr. i.	Compound Pills of Antimony.
Apomorphinæ Hydrochloras.	$C_{17}H_{17}NO_2$ HCl.	Emetic; gr. $\frac{1}{4}$.	
Aqua.	H_2O.		
Aqua Ammoniæ.	NH_3.		**Liniment**, Ammoniated Glycyrrhizin, Ammoniated Mercury, Aromatic Spirit of Ammonia, Citrate of Bismuth and Ammonium, Citrate of Iron and Ammonium, Hydrated Oxide of Iron, Fluid Extract of Glycyrrhiza, Fluid Extract of Senega, Purified Sulphide of Antimony, Pure Extract of Glycyrrhiza, Solution of Acetate of Iron, Solution of Citrate of Iron, Solution of Nitrate of Iron, Tartrate of Iron and Ammonium, Tartrate of Iron and Potassium, Syrup of Lactophosphate of Calcium, Syrup of Senega, Washed Sulphur.
Aqua Ammoniæ Fortior.	NH_3.		**Spirit.**
Aqua Chlori.		Stimulant, antiseptic; f℥i.	
Argenti Cyanidum.	AgCN.	Externally.	Diluted Hydrocyanic Acid.
Argenti Iodidum.	AgI.	Nervine, antisyphilitic; gr. i.	

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Argenti Nitras.	$AgNO_3$.	Stimulant, astringent; gr. ¼.	**Diluted Nitrate of Silver** (with KNO_3). **Moulded Nitrate of Silver** (with HCl).
Argenti Nitras Dilutus.		Caustic.	
Argenti Nitras Fusus.		Caustic.	
Argenti Oxidum.	Ag_2O.	Tonic; gr. ½ – ij.	
Arsenii Iodidum.	AsI_3.	Alterative; gr. ⅛.	Solution of Iodide of Arsenic and Mercury.
Atropina.	$C_{17}H_{23}NO_3$.	Sedative; gr. $\frac{1}{120}$ – $\frac{1}{60}$.	
Atropinæ Sulphas.	$(C_{17}H_{23}NO_3)_2 H_2SO_4$.	Mydriatic; gr. $\frac{1}{60}$.	
Auri et Sodii Chloridum.	$AuCl_3$ and NaCl.	Alterative; gr. $\frac{1}{15}$.	
Benzinum.	C_6H_{12}.	Solvent.	Mustard Paper.
Bismuthi Citras.	$BiC_6H_5O_7$.	Nervine; gr. iij.	Citrate of Bismuth and Ammonium.
Bismuthi et Ammonii Citras.		Nervine; gr. ij.	
Bismuthi Subcarbonas.	$(BiO)_2CO_3$. H_2O.	Astringent, antispasmodic; gr. viij.	
Bismuthi Subnitras.	$BiONO_3.H_2O$.	Astringent, antispasmodic; gr. viij.	Citrate of Bismuth.
Bromum.	Br.	Alterative, stimulant; gr. ½.	Syrup of Bromide of Iron.
Caffeina.	$C_8H_{10}N_4O_2$. H_2O.	Stimulant; gr. iij–x.	
Calcii Bromidum.	$CaBr_2$.	Stimulant, nervine; gr. xxx.	
Calcii Carbonas Precipitatus.	$CaCO_3$.	Antacid, astringent; gr. x–xl.	Compound Powder of Morphine.
Calcii Chloridum.	$CaCl_2$.	Alterative; gr. x.	
Calcii Hypophosphis.	$CaH_4(PO_2)_2$.	Alterative; gr. x.	Syrup of Hypophosphites.
Calcii Phosphas Precipitatus.	$Ca_3(PO_4)_2$.		Syrup of Lactophosphate of Calcium, Antimonial Powder, Syrup of Orange, Compound Syrup of Squill.
Calx.	CaO.	Escharotic.	**Solution, Syrup,** Potassa with Lime, Sulphurated Lime, Purified Chloroform, Solution of Potassa, Solution of Soda, Precipitated Sulphur.
Calx Chlorata.		Disinfectant.	Solution of Chlorinated Soda.
Calx Sulphurata.	CaS and $Ca.SO_4$.	Depilatory.	
Camphora Monobromata.	$C_{10}H_{15}BrO$.	Nervous sedative; gr. v.	
Carbonei Bisulphidum.	CS_2.	Solvent.	
Cerii Oxalas.	$Ce_2(C_2O_4)_3$ $9H_2O$.	Sedative, tonic; gr. ij.	
Chinoidinum.		Antiperiodic; gr. xv.	
Chloral.	C_2HCl_3O. H_2O.	Sedative; gr. x.	
Chloroformum Purificatum.	$CHCl_3$.	Anæsthetic; f℥i.	**Mixture, Spirit,** Pills of Phosphorus.
Chloroformum Venale.	$CHCl_3$.	Solvent, and used externally.	**Purified Chloroform, Liniment,** Collodion with Cantharides, Solution of Gutta-Percha.

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Cinchonidinæ Sulphas.	$(C_{20}H_{24}N_2O)_2 H_2SO_4. 3H_2O.$	Tonic, febrifuge; gr. i–xxx.	
Cinchonina.	$C_{20}H_{24}N_2O.$	Tonic.	
Cinchoninæ Sulphas.	$(C_{20}H_{24}N_2O)_2 H_2SO_4. 2H_2O.$	Tonic, antiperiodic; gr. i–x.	
Codeina.	$C_{18}H_{21}NO_3. H_2O.$	Narcotic; gr. $\frac{1}{4}$–i.	
Creasotum.		Antiferment; m. i.	**Water.**
Creta Præparata.	$CaCO_3.$	Antacid; gr. x–lx.	**Compound Powder, Troches,** Mercury with Chalk.
Cupri Acetas.	$Cu(C_2H_3O_2)_2. H_2O.$	Tonic; gr. $\frac{1}{2}$.	
Cupri Sulphas.	$CuSO_4.5H_2O.$	Tonic, escharotic; gr. $\frac{1}{2}$.	
Elaterinum.	$C_{20}H_{28}O_5.$	Hydragogue cathartic; gr. $\frac{1}{15}$.	**Trituration.**
Ferri Carbonas Saccharatus.		Tonic; gr. v–xx.	
Ferri Chloridum.	$Fe_2Cl_6. 12H_2O.$	Hæmostatic.	
Ferri Citras.	$Fe_2(C_6H_5O_7)_2. 6H_2O.$	Mild tonic; gr. v–xx.	Citrate of Iron and Quinine, Phosphate of Iron, Pyrophosphate of Iron.
Ferri et Ammonii Citras.		Tonic; gr. v.	Citrate of Iron and Strychnine, Solution of Citrate of Iron and Quinine, Wine of Citrate of Iron.
Ferri et Ammonii Sulphas.	$Fe_2(NH_4)_2 (SO_4)_4. 24H_2O.$	Styptic; gr. v.	
Ferri et Ammonii Tartras.		Tonic; gr. x.	
Ferri et Potassii Tartras.		Tonic; gr. x.	
Ferri et Quininæ Citras.		Tonic; gr. v.	
Ferri et Strychninæ Citras.		Tonic; gr. iv.	
Ferri Hypophosphis.	$Fe_2(H_2PO_2)_6.$	Tonic; gr. v.	
Ferri Iodidum Saccharatum.		Tonic, alterative; gr. iij.	
Ferri Lactas.	$Fe(C_3H_5O_3)_2. 3H_2O.$	Tonic; gr. ij.	Syrup of Hypophosphites with Iron.
Ferri Oxalas.	$FeC_2O_4.H_2O.$	Tonic; gr. ij.	
Ferri Oxidum Hydratum.	$Fe_2(HO)_6.$	Antidote.	Iron Plaster, Troches of Iron.
Ferri Oxidum Hydratum cum Magnesia.		Antidote.	
Ferri Phosphas.		Tonic; gr. v.	Syrup of the Phosphates of Iron, Quinine, and Strychnine.
Ferri Pyrophosphas.		Tonic; gr. ij–v.	
Ferri Sulphas.	$FeSO_4.7H_2O.$	Astringent, tonic; gr. ij.	**Dried Sulphate of Iron, Precipitated Sulphate of Iron** (with Alcohol and Sulphuric Acid), Mass of Carbonate of Iron, Compound Iron Mixture, Compound Pills of Iron, Saccharated Carbonate of Iron, Solution of Subsulphate of Iron, Solution of Tersulphate of Iron.
Ferri Sulphas Exsiccatus.	$FeSO_4.H_2O.$	Astringent, tonic; gr. i.	Pills of Aloes and Iron.
Ferri Sulphas Præcipitatus.	$FeSO_4.7H_2O.$	Astringent, tonic; gr. ij.	
Ferri Valerianas.	$Fe_2(C_5H_9O_2)_6.$	Tonic, nervine; gr. i.	

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Ferrum.	Fe.		Chloride of Iron, Saccharated Iodide of Iron, Solution of Chloride of Iron, Syrup of Bromide of Iron, Syrup of Iodide of Iron.
Ferrum Reductum.	Fe.	Tonic; gr. v.	Pills of Iodide of Iron.
Glycerinum.	$C_3H_5(HO)_3$.	Solvent, and used externally.	Glycerites, Extracts, Fluid Extracts, Tinctures, etc.
Glycyrrhizinum Ammoniatum.		Expectorant; gr. x.	
Hydrargyri Chloridum Corrosivum.	$HgCl_2$.	Antisyphilitic, alterative; gr. $\frac{1}{12}$.	Red Iodide of Mercury, Yellow Oxide of Mercury, Ammoniated Mercury.
Hydrargyri Chloridum Mite.	Hg_2Cl_2.	Purgative; gr. v–x.	Compound Pills of Antimony, Compound Cathartic Pills.
Hydrargyri Cyanidum.	$Hg(CN)_2$.	Alterative; gr. $\frac{1}{12}$.	
Hydrargyri Iodidum Rubrum.	HgI_2.	Alterative, antisyphilitic; gr. $\frac{1}{12}$.	Solution of Iodide of Arsenic and Mercury.
Hydrargyri Iodidum Viride.	Hg_2I_2.	Alterative, antisyphilitic; gr. i.	
Hydrargyri Oxidum Flavum.	HgO.	Externally.	**Oleate, Ointment.**
Hydrargyri Oxidum Rubrum.	HgO.	Externally.	**Ointment,** Solution of Nitrate of Mercury.
Hydrargyri Subsulphas Flavus.	$Hg(HgO)_2SO_4$.	Alterative; gr. $\frac{1}{4}$.	
Hydrargyri Sulphidum Rubrum.	HgS.	Sialagogue; gr. v.	
Hydrargyrum.	Hg.		**Mass, Mercury with Chalk, Ointment, Plaster,** Ointment of Nitrate of Mercury, Ammoniac Plaster with Mercury, Green Iodide of Mercury, Yellow Subsulphate of Mercury.
Hydrargyrum Ammoniatum.	NH_2HgCl.	Used externally.	**Ointment.**
Hydrargyrum cum Creta.		Alterative; gr. v.	
Hyoscyaminæ Sulphas.	$(C_{17}H_{23}NO_3)_2.H_2SO_4$.	Sedative; gr. $\frac{1}{60}$.	
Iodoformum.	CHI_3.	Anæsthetic, antiseptic; gr. i.	**Ointment.**
Iodum.	I.	Alterative, stimulant; gr. $\frac{1}{4}$.	**Ointment, Tincture, Compound Solution,** Green Iodide of Mercury, Iodized Starch, Iodide of Sulphur, Pills of Iodide of Iron, Saccharated Iodide of Iron, Syrup of Hydriodic Acid, Syrup of Iodide of Iron.
Liquor Acidi Arseniosi.		Alterative; m. iv.	
Liquor Ammonii Acetatis.		Diaphoretic; f℥iij.	Mixture of Acetate of Iron and Ammonium.
Liquor Arsenii et Hydrargyri Iodidi.		Alterative; m. v.	
Liquor Calcis.	$Ca(HO)_2$.	Antacid; f℥ij.	**Liniment.**
Liquor Ferri Acetatis.	$Fe_2(C_2H_3O_2)_6$.	Tonic; m. v.	**Tincture.**
Liquor Ferri Chloridi.	Fe_2Cl_6.	Styptic.	**Tincture.**
Liquor Ferri Citratis.	$Fe_2(C_6H_5O_7)_2$.	Tonic; m. x.	Citrate of Iron, Citrate of Iron and Ammonium.
Liquor Ferri et Quininæ Citratis.		Tonic; m. xv.	Bitter Wine of Iron.

Officinal Name.	Chemical Composition.	Uses and Dose.	Officinal Preparations in heavy type; those in which the Substance is used in Roman type.
Liquor Ferri Nitratis.	$Fe_2(NO_3)_6$.	Tonic, astringent; m. v.	
Liquor Ferri Subsulphatis.	$Fe_4O(SO_4)_5$.	Styptic; m. iij.	
Liquor Ferri Tersulphatis.	$Fe_2(SO_4)_3$.	Styptic; m. iij.	Hydrated Oxide of Iron, Hydrated Oxide of Iron with Magnesia, Tartrate of Iron and Ammonium, Tartrate of Iron and Potassium, Solution of Acetate of Iron, Solution of Citrate of Iron, Solution of Nitrate of Iron.
Liquor Gutta-Perchæ.		Protective.	Mustard Paper.
Liquor Hydrargyri Nitratis.	$Hg(NO_3)_2$.	Escharotic.	
Liquor Iodi Compositus.		Alterative; m. v.	
Liquor Magnesii Citratis.		Cathartic; f℥xij.	
Liquor Pepsini.		Digestive; f℥ ½–ij.	
Liquor Plumbi Subacetatis.		Externally.	**Cerate, Liniment, Diluted Solution.**
Liquor Plumbi Subacetatis Dilutus.		Externally.	
Liquor Potassæ.	KHO.	Antacid, antilithic; m. x.	Yellow Oxide of Mercury.
Liquor Potassii Arsenitis.		Alterative; m. v.	
Liquor Potassii Citratis.		Refrigerant, diaphoretic; f℥i.	
Liquor Sodæ.	NaHO.	Antacid, antilithic; m. x.	Sulphurated Antimony.
Liquor Sodæ Chloratæ.		Stimulant, antiseptic; m. xxx.	
Liquor Sodii Arseniatis.		Alterative; m. iv.	
Liquor Sodii Silicatis.		Used externally.	
Liquor Zinci Chloridi.	$ZnCl_2$.	Disinfectant.	
Lithii Benzoas.	$LiC_7H_5O_2$.	Diuretic; gr. xv.	
Lithii Bromidum.	LiBr.	Nervine; gr. xv.	
Lithii Carbonas.	Li_2CO_3.	Diuretic; gr. v.	
Lithii Citras.	$Li_3C_6H_5O_7$.	Diuretic; gr. xv.	
Lithii Salicylas.	$2LiC_7H_5O_3$. H_2O.	Antirheumatic; gr. xxv.	
Magnesia.	MgO.	Antacid, laxative; gr. xx.	**Troches,** Hydrated Oxide of Iron with Magnesia, Compound Powder of Rhubarb, Mass of Copaiba.
Magnesia Ponderosa.	MgO.	Antacid, laxative; gr. xx.	
Magnesii Carbonas.	$(MgCO_3)_4$. $Mg(HO)_2$. $5H_2O$.	Antacid; gr. lx.	Solution of Citrate of Magnesium, Mixture of Magnesia and Asafetida, Granulated Citrate of Magnesium.
Magnesii Citras Granulatus.		Cathartic; gr. lx.	
Magnesii Sulphas.	$MgSO_4$. $7H_2O$.	Cathartic; ℥i.	Compound Infusion of Senna.
Magnesii Sulphis.	$MgSO_3$. $6H_2O$.	Antiferment; gr. xv.	

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Mangani Oxidum Nigrum.	MnO_2.	Tonic, alterative; gr. v.	Chlorine Water.
Mangani Sulphas.	$MnSO_4.4H_2O$.	Cholagogue, tonic; gr. x.	
Massa Ferri Carbonatis.		Tonic; gr. xv.	
Massa Hydrargyri.		Purgative; gr. x.	
Morphina.	$C_{17}H_{19}NO_3$. H_2O.	Sedative; gr. $\frac{1}{8}$.	
Morphinæ Acetas.	$C_{17}H_{19}NO_3$. $HC_2H_3O_2$. $3H_2O$.	Sedative; gr. $\frac{1}{8}$.	
Morphinæ Hydrochloras.	$C_{17}H_{19}NO_3$. $HCl.3H_2O$.	Sedative; gr. $\frac{1}{8}$.	
Morphinæ Sulphas.	$(C_{17}H_{19}NO_3)_2$. H_2SO_4. $5H_2O$.	Sedative; gr. $\frac{1}{8}$.	**Compound Powder,** Troches of Morphine and Ipecac.
Oleum Æthereum.		Anodyne; m. i.	Compound Spirit of Ether.
Petrolatum.	$C_{16}H_{34}$.	Externally.	
Phosphorus.	P.	Aphrodisiac, stimulant; gr. $\frac{1}{100}$.	**Phosphoric Acid** (with Nitric Acid), **Pills,** Phosphorated Oil.
Physostigminæ Salicylas.	$C_{15}H_{21}N_3O_2$ $C_7H_6O_3$.	Sedative; gr. $\frac{1}{60}$.	
Picrotoxinum.	$C_9H_{10}O_4$.	Sedative; gr. $\frac{1}{60}$.	
Pilocarpinæ Hydrochloras.	$C_{11}H_{16}N_2O_2$. HCl.	Diaphoretic; gr. $\frac{1}{8}$.	
Piperina.	$C_{17}H_{19}NO_3$.	Stimulant; gr. v.	
Plumbi Acetas.	$Pb(C_2H_3O_2)_2$. $3H_2O$.	Astringent, sedative; gr. ij.	Solution of Subacetate of Lead.
Plumbi Carbonas.	$(PbCO_3)_2$. $Pb(HO)_2$.	Externally.	**Ointment,** Solution of Gutta-Percha.
Plumbi Iodidum.	PbI_2.	Externally.	**Ointment.**
Plumbi Nitras.	$Pb(NO_3)_2$.	Externally.	
Plumbi Oxidum.	PbO.	Externally.	Lead-Plaster, Solution of Subacetate of Lead.
Potassa.	KHO.	Escharotic.	**Solution,** Potassa with Lime.
Potassa cum Calce.		Escharotic.	
Potassa Sulphurata.		Antacid; gr. iij.	
Potassii Acetas.	$KC_2H_3O_2$.	Diuretic; gr. xx.	
Potassii Bicarbonas.	$KHCO_3$.	Antacid, diuretic; gr. xv.	Mixture of Citrate of Potassium, Solution of Citrate of Magnesium, Solution of Potassa, Solution of Arsenite of Potassium, Solution of Citrate of Potassium.
Potassii Bichromas.	$K_2Cr_2O_7$.	Escharotic.	
Potassii Bitartras.	$KHC_4H_4O_6$.	Purgative; ʒi–iv.	Tartrate of Iron and Potassium, Compound Powder of Jalap.
Potassii Bromidum.	KBr.	Nervine; gr. xx.	
Potassii Carbonas.	$(K_2CO_3)_2$. $3H_2O$.	Antacid, diuretic; gr. xv.	Alkaline Sulphur Ointment, Compound Mixture of Iron, Sulphurated Potassa, Syrup of Rhubarb.
Potassii Chloras.	$KClO_3$.	Alterative; gr. xv.	**Troches.**
Potassii Citras.	$K_3C_6H_5O_7$. H_2O.	Refrigerant; gr. xx.	
Potassii Cyanidum.	KCN.	Sedative; gr. $\frac{1}{12}$.	
Potassii et Sodii Tartras.	$KNaC_4H_4O_6$. $4H_2O$.	Purgative; ʒiv.	Compound Effervescing Powder.
Potassii Ferrocyanidum.	$K_4Fe(CN)_6$. $3H_2O$.	Sedative; gr. x.	Diluted Hydrocyanic Acid.

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Potassii Hypophosphis.	KH_2PO_2.	Alterative; gr. xv.	Syrup of Hypophosphites.
Potassii Iodidum.	KI.	Alterative; gr. v.	**Ointment,** Compound Solution of Iodine, Iodine Ointment, Red Iodide of Mercury.
Potassii Nitras.	KNO_3.	Refrigerant, diuretic; gr. x.	**Paper,** Diluted Nitrate of Silver.
Potassii Permanganas.	$K_2Mn_2O_8$.	Disinfectant, emmenagogue; gr. i.	
Potassii Sulphas.	K_2SO_4.	Purgative; gr. lx.	
Potassii Sulphis.	K_2SO_3. $2H_2O$.	Antiferment; gr. xv.	
Potassii Tartras.	$(K_2C_4H_4O_6)_2$. H_2O.	Purgative; ʒij.	
Pyroxylinum.			Collodion
Quinidinæ Sulphas.	$(C_{20}H_{24}N_2O_2)_2$ H_2SO_4. $2H_2O$.	Tonic; gr. v.	
Quinina.	$C_{20}H_{24}N_2O_2$. $3H_2O$.	Tonic; gr. v.	Citrate of Iron and Quinine, Solution of Citrate of Iron and Quinine, Syrup of the Phosphates of Iron, Quinine, and Strychnine.
Quininæ Bisulphas.	$C_{20}H_{24}N_2O_2$ H_2SO_4. $7H_2O$.	Tonic; gr. v.	
Quininæ Hydrobromas.	$C_{20}H_{24}N_2O_2$ $HBr.2H_2O$.	Tonic; gr. v.	
Quininæ Hydrochloras.	$C_{20}H_{24}N_2O_2$ $HCl.2H_2O$.	Tonic; gr. v.	
Quininæ Sulphas.	$(C_{20}H_{24}N_2O_2)_2$ H_2SO_4. $7H_2O$.	Tonic; gr. v.	
Quininæ Valerianas.	$C_{20}H_{24}N_2O_2$ $C_5H_{10}O_2$. H_2O.	Tonic; gr. ij.	
Saccharum.	$C_{12}H_{22}O_{11}$.		**Syrup,** Syrups, Troches, etc.
Salicinum.	$C_{13}H_{18}O_7$.	Tonic; gr. x.	
Santoninum.	$C_{15}H_8O_3$.	Anthelmintic; gr. ij.	
Sapo.		Antacid; gr. x.	**Plaster, Liniment,** Compound Extract of Colocynth, Pills of Aloes, Pills of Aloes and Asafetida, Pills of Asafetida, Pills of Opium, Pills of Rhubarb.
Sapo Viridis.		Externally.	**Tincture.**
Soda.	NaHO.	Escharotic.	**Solution.**
Sodii Acetas.	$NaC_2H_3O_2$. $3H_2O$.	Diuretic; gr. xx.	
Sodii Arsenias.	Na_2HAsO_4. $7H_2O$.	Alterative; gr. $\frac{1}{12}$.	**Solution.**
Sodii Benzoas.	$NaC_7H_5O_2$. H_2O.	Antirheumatic; gr. lx.	
Sodii Bicarbonas.	$NaHCO_3$.	Antacid; gr. xv.	**Troches,** Compound Effervescing Powder, Granulated Citrate of Magnesium, Mixture of Rhubarb and Soda, Saccharated Carbonate of Iron.
Sodii Bicarbonas Venalis.	$NaHCO_3$.	Antacid; gr. xv.	
Sodii Bisulphis.	$NaHSO_3$.	Antiseptic; gr. v.	
Sodii Boras.	$Na_2B_4O_7$. $10H_2O$.	Refrigerant, diuretic; gr. xv.	
Sodii Bromidum.	NaBr.	Nervine; gr. xxx.	

Officinal Name.	Chemical Composition.	Uses and Dose.	Officinal Preparations in heavy type; those in which the Substance is used in Roman type.
Sodii Carbonas.	Na_2CO_3. $10H_2O$.	Antacid; gr. x.	**Dried Carbonate,** Compound Pills of Iron, Hydrate of Aluminium, Mass of Carbonate of Iron, Purified Chloroform, Solution of Chlorinated Soda, Solution of Soda.
Sodii Carbonas Exsiccatus.	Na_2CO_3.	Antacid; gr. v.	
Sodii Chloras.	$NaClO_3$.	Alterative; gr. x.	
Sodii Chloridum.	NaCl.	Tonic; gr. xx.	
Sodii Hypophosphis.	NaH_2PO_2. H_2O.	Nervine, tonic; gr. v.	Syrup of Hypophosphites.
Sodii Hyposulphis.	$Na_2S_2O_3$. $5H_2O$.	Alterative; gr. x.	Ointment of Iodide of Potassium.
Sodii Iodidum.	NaI.	Alterative; gr. xv.	
Sodii Nitras.	$NaNO_3$.	Diuretic; gr. xv.	
Sodii Phosphas.	Na_2HPO_4. $12H_2O$.	Purgative; ʒi.	Phosphate of Iron.
Sodii Pyrophosphas.	$Na_4P_2O_7$. $10H_2O$.	Purgative; gr. x.	Pyrophosphate of Iron.
Sodii Salicylas.	$2NaC_7H_5O_3$. H_2O.	Stimulant; gr. xxx.	
Sodii Santoninas.	$2NaC_{15}H_{19}O_4$. $7H_2O$.	Anthelmintic; gr. iij.	**Troches.**
Sodii Sulphas.	Na_2SO_4. $10H_2O$.	Cathartic; ʒij–iv.	
Sodii Sulphis.	Na_2SO_3. $7H_2O$.	Antiferment; gr. x.	
Sodii Sulphocarbolas.	$NaC_6H_5SO_4$. $2H_2O$.	Antiferment; gr. xx.	
Strychnina.	$C_{21}H_{22}N_2O_2$.	Tonic; gr. $\frac{1}{60}$.	Citrate of Iron and Strychnine, Syrup of the Phosphates of Iron, Quinine, and Strychnine.
Strychninæ Sulphas.	$(C_{21}H_{22}N_2O_2)_2$ H_2SO_4. $7H_2O$.	Tonic; gr. $\frac{1}{60}$.	
Sulphuris Iodidum.		Externally.	
Sulphur Lotum.	S.	Diaphoretic, resolvent; ʒi.	Alkaline Sulphur Ointment, Compound Powder of Glycyrrhiza, Iodide of Sulphur.
Sulphur Præcipitatum.	S.	Diaphoretic, resolvent; ʒi.	
Sulphur Sublimatum.	S.	Diaphoretic, resolvent; ʒi.	**Ointment,** Ammoniac Plaster with Mercury, Sulphurated Potassa, Precipitated Sulphur, Washed Sulphur.
Thymol.	$C_{10}H_{13}HO$.	Antiseptic.	
Veratrina.		Externally.	**Oleate, Ointment.**
Zinci Acetas.	$Zn(C_2H_3O_2)_2$. $3H_2O$.	Externally.	
Zinci Bromidum.	$ZnBr_2$.	Nervine; gr. v.	
Zinci Carbonas Præcipitatus.	$(ZnCO_3)_2$. $3Zn(HO)_2$.	Externally.	Solution of Chloride of Zinc.
Zinci Chloridum.	$ZnCl_2$.	Escharotic.	
Zinci Iodidum.	ZnI_2.	Externally.	
Zinci Oxidum.	ZnO.	Externally.	**Ointment.**
Zinci Phosphidum.	Zn_3P_2.	Aphrodisiac; gr. $\frac{1}{4}$.	
Zinci Sulphas.	$ZnSO_4.7H_2O$.	Astringent; gr. ij.	
Zinci Valerianas.	$Zn(C_5H_9O_2)_2$. H_2O.	Antispasmodic; gr. i.	
Zincum.	Zn.		Solution of Chloride of Zinc.

PART IV.

ORGANIC SUBSTANCES.

INTRODUCTORY.

THE view formerly held by chemists, that vegetable and animal substances owed their peculiar chemical and physical properties exclusively to the mysterious action of life, was seriously affected by the labors of such chemists as Wöhler, in 1828, and Kolbe and Frankland, in 1847, who succeeded in producing synthetically a number of compounds from mineral substances. These so-called artificial bodies were proved to be identical in chemical composition and physical properties with those obtained from nature, and the subsequent discovery of many others has necessitated a change in the definition of the term *organic chemistry*. This no longer means the study of substances produced through living organisms, but, as all organic bodies have been found upon analysis to contain carbon (generally associated with hydrogen, and often with oxygen and nitrogen), the following modern definition must be accepted: *Organic chemistry is the science which treats of the carbon compounds.*

The plan of this work will not admit of the acceptance of the latest systems of classification which have been advanced, for, notwithstanding the ingenious skill which is clearly perceptible in many of the groupings, they are not well adapted for the study of the carbon compounds from a pharmaceutical point of view. The groups which are characterized in modern organic chemistry as alcohols, ethers, compound ethers, aldehyds, ketones, amines, and amides, necessarily bring together many substances used in the materia medica which possess few pharmaceutical or medical analogies. For instance, glycerin, mannit, and carbolic acid are properly regarded as alcohols, and they would have to be grouped together, notwithstanding their physical dissimilarities. The same classification would compel the consideration of such an incongruous pharmaceutical group as spirit of nitrous ether, stearin, and beeswax under the head of compound ethers.

It must not be understood that the present methods of grouping the carbon atoms is not of great value *in studying chemistry* from a purely chemical stand-point. Indeed, with the enormous advances which have been made in theoretical chemistry within the last half-century, it would be impossible to reject the results upon which the present system of classification rests.

In the following pages the carbon compounds are considered in the usual groups only when the substances composing them have similar chemical and physical properties. The opening chapters are devoted to lignin and its derivatives; then its isomer, starch, and the allied products, gums, mucilages, etc.; then the sugars and the products derived from them as the result of decomposition and fermentation, alcohol, ether, etc. Following these the acid saccharine fruits, with the important acids which they contain, are considered, and then the products obtained from them and from other plants,—the volatile oils. Oleoresins, resins, gum-resins, and balsams naturally succeed these, and then the classification is based upon the prominent constituents which are found in the substances, astringents, cathartics, etc., being all grouped together. Drugs containing alkaloids are among the last groups of carbon compounds. The alkaloids are highly organized, and most of them are powerful poisons. This plan thus begins with elementary substances, like lignin, starch, and gum, and leads by regular progression to the most powerful compounds in the materia medica, the alkaloids.

A sharp distinction is made between the officinal and the unofficinal preparations, the latter always following the former. This will enable the student to distinguish at a glance the more important compounds, and they can be studied either together or separately at will.

CHAPTER XLIX.

THE CELLULIN GROUP.

Cellulin. $C_6H_{10}O_5$.

Cellulin.—The woody fibre of plants, which forms the skeleton or framework for the vegetable tissues, is termed *cellulin*, or *cellulose*. During the natural growth of the plant the walls of the cells become filled with various principles, coloring-matter, resins, salts of various kinds, etc., and these give to the plant physical properties which render it useful in medicine. Pharmacy teaches the various methods of extracting the *valuable principles* from plants. Cellulin constitutes the greater part of the inert residues. (See Percolation, page 227.)

The term *lignin* was formerly applied to cellulin; indeed, three words, *lignin*, *cellulin*, and *cellulose*, were used synonymously: a distinction, however, is now made, the substances which are found adhering to the cellulin skeleton of plants and vegetable tissues being called *lignin*. The latter is less digestible than cellulin, and it is believed by Payen and others to vary from it somewhat in chemical composition. *Fungin*, from fungi, *hordein*, from barley, *medullin*, from the pith of various plants, *pollenin*, from pollen granules, are mixed and special forms of cellulin.

Cellulin is seen in a pure form in raw cotton, the hairs of the seed of various species of Gossypium, and in many other vegetable products. It is the most useful and valuable substance obtained from plants: fabrics like cotton, linen, or hemp goods are made on an immense scale from cellulin. When pure, cellulin is white, translucent, unalterable in the air, and has the specific gravity of 1.5. It is insoluble in water, alcohol, ether, benzin, and oils, but is soluble in an ammoniacal solution of oxide of copper, and this latter fact has been taken advantage of to form many useful articles by partially dissolving a woven cotton material and rolling or pressing it into any desired shape. When cellulin is treated with strong sulphuric acid or phosphoric acid, it is converted into dextrin. If the mixture be diluted with water and heated, glucose is produced. If cellulin in the form of unsized paper is passed through a mixture made from two parts of sulphuric acid of sp. gr. 1.840 and one part of water (*both by measure*), and the whole *cooled to* 15° C. (59° F.), the valuable product known as *parchment-paper* is produced. The strips of paper should be well washed by passing them through a dilute solution of ammonia and water. This paper is useful as a dialyzing medium; it forms, when perfect, the best

septum. (See Dialysis.) When cellulin is treated with nitric acid, pyroxylin, or gun cotton, is produced.

GOSSYPIUM. *U. S.* Cotton.

[PURIFIED COTTON. ABSORBENT COTTON.]

The hairs of the seed of *Gossypium herbaceum* Linné, and of other species of Gossypium (Nat. Ord. *Malvaceæ*), freed from adhering impurities and deprived of fatty matter.

Purified cotton wool is cellulin in one of its purest forms. For a long time one of the most important uses of this valuable staple, that of an absorbent and substitute for sponge, was neglected, because a trace of fatty matter was permitted to remain, which coated the filaments and prevented it from absorbing liquids freely and uniformly. The so-called absorbent cotton of commerce was introduced, and it soon became an important product. This is cotton freed from the trace of fatty matter by boiling it in a weak alkaline solution, rinsing it in a weak solution of chlorinated lime to whiten it, dipping it into a very dilute solution of hydrochloric acid, and then thoroughly rinsing it with pure water; the cotton having been thoroughly dried, is then carded. The loss is about ten per cent. Cellulin is employed in pharmacy in the form of filtering paper, in muslin and cotton cloth strainers, for surgical bandages, paper, lint, etc.

Products resulting from the Decomposition of Cellulin.

Under this head will be included—1. The preparations made by decomposing cellulin or lignin by the action of acids or alkalies. 2. Those made by destructive distillation.

Pyroxylin is placed in the first class, primarily because of its importance in pharmacy, medicine, and the arts.

PYROXYLINUM. *U. S.* Pyroxylin.

[PYROXYLON, Pharm. 1870. SOLUBLE GUN COTTON.]

Cotton, 1 part, or	½ oz. av.
Nitric Acid, 10 parts, or	5 oz. av.
Sulphuric Acid, 12 parts, or	6 oz. av.
Alcohol,	
Stronger Ether,	
Water, each, a sufficient quantity.	

Mix the Acids gradually in a glass or porcelain vessel, and, when the temperature of the mixture has fallen to 32° C. (90° F.), add the Cotton. By means of a glass rod imbue it thoroughly with the Acids, and allow it to macerate for ten hours, or until a small sample of the Cotton, taken out, thoroughly washed with a large quantity of Water and subsequently with Alcohol and pressed, is found to be soluble, when shaken in a test-tube with a mixture of *one volume* [or 1 fl. dr.] of Alcohol and *three volumes* [or 3 fl. dr.] of Stronger Ether. Then remove the Cotton from the Acids, transfer it to a larger vessel and wash it, first with cold Water until the washings cease to have an acid taste, and afterwards with boiling Water. Finally drain the Pyroxylin on

filtering paper and dry it, in small, detached pellets, by means of a water-bath. Pyroxylin should be kept loosely packed, in well-closed vessels, containing not more than about 31 grammes (or about 480 grains), in a cool and dry place, remote from lights or fire.

Schönbein first pointed out the fact that nitric acid acts on cotton and produces a soluble compound. It was subsequently proved that this substance, pyroxylin, or gun cotton, belongs to a series of closely related nitro-compounds. These are three in number,—*i.e.*, mono-nitro-cellulin, di-nitro-cellulin, and tri-nitro-cellulin. They are produced through the action of nitric acid of various strengths upon the cellulin; nitrogen dioxide (NO_2) being substituted for one, two, or three hydrogen atoms in the cellulin, as shown below:

$$\underset{\text{Nitric Acid.}}{HNO_3} + \underset{\text{Cellulin.}}{C_6H_{10}O_5} = \underset{\text{Mono-nitro-cellulin.}}{C_6H_9(NO_2)O_5} + \underset{\text{Water.}}{H_2O.}$$

$$\underset{\text{Nitric Acid.}}{2HNO_3} + \underset{\text{Cellulin.}}{C_6H_{10}O_5} = \underset{\text{Di-nitro-cellulin.}}{C_6H_8(2NO_2)O_5} + \underset{\text{Water.}}{2H_2O.}$$

$$\underset{\text{Nitric Acid.}}{3HNO_3} + \underset{\text{Cellulin.}}{C_6H_{10}O_5} = \underset{\text{Tri-nitro-cellulin.}}{C_6H_7(3NO_2)O_5} + \underset{\text{Water.}}{3H_2O.}$$

Mono-nitro-cellulin is insoluble in a mixture of ether and alcohol, and is not explosive. *Di-nitro-cellulin is the officinal pyroxylin.* It is soluble in a mixture of ether and alcohol (see Collodium), but is slightly explosive. Tri-nitro-cellulin is highly explosive, and is insoluble in a mixture of ether and alcohol.

Uses.—Pyroxylin has been used very largely by photographers for producing the basis of the sensitized film upon which impressions are made. It is now replaced to a great extent by gelatin. The composition known as *celluloid*, which is used so largely for useful and ornamental articles, is made from pyroxylin, camphor, and coloring-matter heated together and powerfully pressed into appropriate moulds. Pharmaceutically, pyroxylin is used in collodions (see page 284).

Officinal Preparations of Pyroxylin.

Collodium . . . . . This is made by placing 4 parts of pyroxylin in a tared bottle and adding 26 parts of alcohol and allowing it to stand for fifteen minutes, to permit the penetration of the alcohol to all parts of the pyroxylin; 70 parts of stronger ether are now added, and the mixture shaken until the pyroxylin is dissolved. Pyroxylin is not soluble in pure ether or pure alcohol, but a mixture of the two in the above proportions makes the best solvent. Pyroxylin, even of the best quality, is never entirely soluble: hence the direction to decant the liquid from any sediment and transfer it to bottles. The sediment consists of little filaments, probably of unaltered cotton: many physicians prefer to shake the bottle so as to incorporate the sediment, under the belief that the film is stronger on account of their presence. Collodion should be dispensed in a small bottle having a cork stopper, and the cork should be perforated so that a camel's-hair brush may be inserted, the brush being kept in the liquid. Collodion is used to protect inflamed surfaces by applying a small quantity with a brush: a thin, closely-adherent film remains after the ether and alcohol evaporate; this film is contractile, and is useful on this account in many minor surgical operations. It is desirable at times to have a flexible film, especially when applied to parts of the body which are required to be in motion. The following preparation may then be used (see page 284):

Collodion.

Collodium Flexile . . . This is made by mixing 5 parts of Canada turpentine and 3 parts of castor oil with 92 parts of collodion. If an astringent application is needed to a bleeding surface, the styptic collodion may be employed (see page 285).

Flexible Collodion.

Collodium Stypticum . This is made by placing 20 parts of tannic acid in a tared bottle, adding 5 parts of alcohol, 20 parts of stronger ether, and 55 parts of collodion, then agitating until the tannic acid is dissolved. If a blistering effect is desired, the cantharidal collodion may be used (see page 285).

Styptic Collodion.

Collodium cum Cantharide. This is made by percolating 60 parts of powdered cantharides with commercial chloroform until the cantharides are exhausted, then recovering by distillation all but one-fifth of the percolate, and, after evaporating the residue by a water-bath to 15 parts, mixing it with 85 parts of flexible collodion. Cantharidin, the vesicating principle of cantharides, is very soluble in chloroform, and, although the first cost of the menstruum is greater than that of ether (the solvent formerly used), it has the advantage over ether of not being inflammable. There is considerable loss of menstruum in carrying out the process practically. The percolator shown on page 366 may be used, and distillation very carefully performed with a condenser having a large refrigerating surface (see page 285).

Cantharidal Collodion.

Acidum Oxalicum. *Oxalic Acid.*

$H_2C_2O_4 2H_2O$; 126.

This acid was omitted from the alphabetical list of chemical substances in the U. S. Pharmacopœia: it is found, however, in the officinal test-solutions.

Preparation.—Oxalic acid may be made by acting on cellulin, sugar, or starch with nitric acid, with the aid of heat, but is prepared on a commercial scale by heating saw-dust with a mixture of two molecules of caustic soda and one molecule of potassa. The mixture of caustic alkalies and saw-dust is made in a thick paste, and then heated for several hours to a temperature of 200° C. (392° F.) to 220° C. (428° F.). The gray mass is then washed with sodium carbonate, whereby the potash is removed as carbonate, the less soluble sodium oxalate remaining. This is converted into calcium oxalate by milk of lime, and the calcium salt is then decomposed with sulphuric acid. The impure oxalic acid is then purified by recrystallization.

It occurs in small, colorless, prismatic crystals, which are odorless and have a very sour taste; it is slightly efflorescent in dry air, fusible at 98° C. (208° F.), and entirely volatile at a red heat.

The crystals should dissolve in not less than eight to ten parts of distilled water at 15° C. (59° F.) (greater solubility indicating contamination with adherent nitric acid). It is soluble in 4.5 parts of absolute alcohol, and in 7 parts of alcohol, and almost insoluble in ether, chloroform, benzol, and benzin. It fuses in its water of hydration at 98° C. (208.4° F.), although continued exposure to a heat of 60° C. (140° F.) to 70° C. (158° F.) will render it perfectly anhydrous. Solutions of oxalic acid at 100° C. (212° F.) lose acid by sublimation, and at 157° C. (314.6° F.) it sublimes rapidly. If the heat rise to 160° C. (320° F.), much loss of acid occurs.

It combines with salifiable bases, and forms salts called oxalates. The most important of these are the three *potassium salts,—oxalate, binoxalate,* and *quadroxalate* (acid potassium oxalate plus free oxalic acid), *ammonium oxalate* (used as a test), and *calcium oxalate.* The binoxalate and quadroxalate, both popularly called *salt of sorrel* or *essential salt of lemons,* are employed for removing iron moulds from linen, and act by

their excess of acid, which forms a soluble salt with the ferric oxide constituting the stain.

This acid in solution combines readily with lime, and forms with it an insoluble white precipitate consisting of calcium oxalate, which is insoluble in an excess of oxalic or acetic acid, but is dissolved by dilute hydrochloric acid.

Uses.—This acid is used analytically in volumetric estimations, particularly of alkalies. It is valuable in this connection, because a pure acid may be easily obtained. The indications afforded are generally distinct, and the solution may be made quickly. (See Test-Solutions.)

The best antidote to poisoning by oxalic acid is a paste made by mixing prepared chalk or powdered chalk with water or lime-water: it must be administered promptly and freely.

Products resulting from the Destructive Distillation of Cellulin and Lignin.

When wood is distilled in close vessels many products are obtained. These vary with the kind of wood used, the care used in the distillation, and the temperature at which the distillation is effected. When dry hard woods (oak, walnut, or beech) are distilled, about 25 per cent. of charcoal is obtained, the liquid portion amounts to about 53 per cent., whilst the remainder, 22 per cent., is represented by waste products, principally uncondensible gases, carbon dioxide, carbon monoxide, etc. The principal solid, liquid, and gaseous products are shown by the following list:

Solids.—Charcoal, inorganic salts, etc. **Liquids.**—1. Aqueous liquid, containing *acetic, formic, butyric, crotonic, capronic, propionic acids, acetone, methylic alcohol, furfurol, methylamine, pyrocatechin,* and small quantities of empyreumatic oils and resins. 2. *Tarry liquid,* containing *toluol, xylol, cumol, methol, mesitylene, pseudocumol, phenol, cresol, guaiacol, creasol, phlorol, and methylcreasol, naphthalene, paraffin, pyrene, chrysene, retene, mesit.* **Gases.**—*Carbon dioxide, carbon monoxide, marsh-gas, acetylene, ethylene, propene,* and others. The most important products are charcoal, tar, acetic acid, acetone, methylic alcohol, and creasote. Of these, charcoal has been considered in Part III.

ACIDUM ACETICUM. *U.S.* Acetic Acid.

A liquid composed of 36 per cent. of absolute Acetic Acid [$HC_2H_3O_2$; 60] and 64 per cent. of water.

Preparation.—The best acetic acid for pharmaceutical and medical uses is now made by subjecting oak wood, cut into small billets, to a carefully-regulated heat, the temperature being much less than that necessary to produce charcoal. The advantages are that the production of the empyreumatic substances which constitute the most objectionable impurities in the commercial acid is largely curtailed, the process being at the same time more economical, as the residue of slightly darkened wood is more valuable than the completely charred carbon left by the ordinary process (see U. S. Dispensatory, 15th edition, p. 27).

Acetid acid is also made by distilling *vinegar*, a liquid made by the oxidation of dilute alcoholic liquids, such as cider, wine, etc. In Germany acetic acid is made by mixing alcohol with water in the proportion of eight parts of the former to ninety-two parts of the latter, and then pouring it upon beech-wood shavings, so that as it trickles through it is oxidized by the action of the air in contact. Aldehyd is an intermediate product in this process.

Acidum Aceticum. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A clear, colorless liquid, wholly volatilized by heat. Sp. gr. 1.048.	Distinctly vinegar-like odor; purely acid taste; strongly acid reaction.	Cold. All proportions. Boiling. All proportions.	Cold. All proportions. Boiling. All proportions.

Test for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
Neutralized with water of ammonia it is colored deep red by ferric chloride, and decolorized again by strongly acidulating with sulphuric acid. To neutralize 6.0 Gm. should require 36 C.c. of the volumetric solution of soda.	Lead, Copper, Tin.	Precipitated with hydrosulphuric acid.
	Iron.	Precipitated when supersaturated with water of ammonia.
	Calcium.	Precipitated with test-solution of oxalate of ammonium.
	Copper.	Blue tint when slightly supersaturated with water of ammonia.
	Acid and Fixed Impurities.	Residue left on evaporating the acid in a water-bath.
	Empyreumatic Substances.	Smoky odor or taste when supersaturated with solution of potassa; diluted with 5 volumes of distilled water, the color caused by the addition of a few drops of test-solution of permanganate of potassium is sensibly changed by standing five minutes at the ordinary temperature.
	Organic Substances.	Darkened by boiling the acid with an equal volume of sulphuric acid.
	Nitric Acid.	Brown or reddish-brown zone around the crystal on adding a crystal of ferrous sulphate to a cooled mixture of equal volume of acetic and sulphuric acids.
	Sulphuric Acid.	Precipitated on the addition of a few drops of test-solution of chloride of barium.
	Hydrochloric Acid.	Precipitated by adding some test-solution of nitrate of silver.
	Sulphurous Acid.	Turned dark on being warmed after the last-named addition.

Two strengths of acetic acid are found in commerce,—the officinal acid, which has the sp. gr. 1.048, and the No. 8 acid, as it is called, which is still very largely used: the latter has the sp. gr. 1.040, and is 20 per cent. weaker than the officinal acid. It is termed "No. 8" because it was formerly used in the proportion of one part in eight to make the ordinary diluted acetic acid, or distilled vinegar. The salts of acetic acid are termed acetates: they are all soluble in water, and may be recognized by heating with sulphuric acid, when the odor of acetic acid will be developed; a neutral solution of an acetate is colored deep red by a solution of ferric chloride, and, if the mixture is boiled, a brownish-red oxyacetate is precipitated.

ACIDUM ACETICUM DILUTUM. *U. S.* **Diluted Acetic Acid.**

Acetic Acid, 17 parts, or	8 fl. oz.
Distilled Water, 83 parts, or	41 fl. oz.
To make 100 parts, or	about 3 pints.

This is the liquid which is used as the menstruum for the officinal vinegars (see page 369): it contains 6 per cent. of absolute acetic acid, $HC_2H_3O_2$, and has the sp. gr. 1.0083. To neutralize 24 Gm. of Diluted Acetic Acid should require 24 C.c. of the volumetric solution of soda. Diluted acetic acid is superior to vinegar as a menstruum, because of its greater purity, more uniform strength, and freedom from color.

ACIDUM ACETICUM GLACIALE. *U. S.* **Glacial Acetic Acid.**

$HC_2H_3O_2$; 60.

Nearly or quite absolute Acetic Acid.

Preparation.—This acid is made by heating carefully fifty-four parts of pure crystallized sodium acetate until the water of crystallization has been completely driven off; the fused residue is coarsely powdered, placed in a retort, mixed with forty parts of pure concentrated sulphuric acid, and distilled: the distillate is glacial acetic acid.

$$\underset{\text{Sodium Acetate.}}{NaC_2H_3O_2} + \underset{\text{Sulphuric Acid.}}{H_2SO_4} = \underset{\text{Glacial Acetic Acid.}}{HC_2H_3O_2} + \underset{\text{Acid Sodium Sulphate.}}{NaHSO_4}.$$

Acidum Aceticum Glaciale. *U.S.*	Quantitative Test.
At or below 15° C. (59° F.) a crystalline solid, at higher temperatures a colorless liquid. Sp. gr. 1.056 to 1.058 at 15° C. (59° F.).	To neutralize 3 Gm. should require not less than 49.5 C.c. of the volumetric solution of soda.

The specific gravity of glacial acetic acid (100 per cent.) is 1.0553, and the specific gravity of 43 per cent. acid is nearly the same, 1.0552, whilst 80, 79, 78, and 77 per cent. acids have exactly the same density,—namely, 1.0748. It will thus be seen that specific gravity cannot be relied upon as a criterion for strength. The glacial acid may, however, be distinguished from the 43 per cent. acid by adding 10 per cent. of water, when, if the density increases, the specimen is the stronger acid. (See Oudemans' table, U. S. Dispensatory, 15th ed., page 27.)

Uses.—Glacial acetic acid is a solvent for oil of lemon and other oils; it is used in the solution of acetate of iron, and, medicinally, it is a caustic and vesicant when applied externally. It is often sold in various disguises as a corn-solvent.

PIX LIQUIDA. *U. S.* **Tar.**

An empyreumatic oleoresin obtained by the destructive distillation of the wood of *Pinus palustris* Miller, and of other species of *Pinus* (Nat. Ord. *Coniferæ*).

Tar is usually obtained as a by-product in the manufacture of charcoal or acetic acid (see page 653). It is thick, viscid, semi-fluid, blackish brown, heavier than water, transparent in thin layers, becoming granular and opaque by age; having an acid reaction, an empyreumatic, terebinthinate odor, and a sharp, empyreumatic taste; slightly soluble in water, soluble in alcohol, in fixed or volatile oils, and in solution of

potassa or of soda. The volatile products of tar are expectorant, and tar inhalations are often used. Externally, tar is stimulating, and is used in skin diseases.

Officinal Preparations.

Syrupus Picis Liquidæ . . . Made by washing 6 parts of tar with cold water, pouring 50 parts of boiling distilled water upon the residue, filtering the solution, and dissolving 60 parts of sugar in the filtrate (see page 265). Dose, one to two fluidrachms.
Syrup of Tar.

Unguentum Picis Liquidæ . Made by mixing 50 parts of tar with 50 parts of melted suet, straining, and stirring until cold. (See Unguenta.)
Tar Ointment.

OLEUM PICIS LIQUIDÆ. *U. S.* Oil of Tar.

A volatile oil distilled from Tar.

Oil of tar is an almost colorless liquid when freshly distilled, but soon acquires a dark, reddish-brown color, having a strong, tarry odor and taste, and an acid reaction. Sp. gr. about 0.970. It is readily soluble in alcohol.

The constituents of oil of tar are complex and numerous (see page 653): the residue left after the distillation of tar is *black pitch*. The oil is preferred to tar for most medicinal uses, because the insoluble and inert resins have been separated.

CREASOTUM. *U. S.* Creasote.

Preparation.—This is a product of the distillation of wood-tar, consisting mainly of the following phenols: *guiacol*, or *oxycresol*, $C_7H_8O_2$, boiling at 200° C. (392° F.), *creasol*, $C_8H_{10}O_2$, boiling at 217° C. (422.6° F.), *methyl-creasol*, $C_9H_{12}O_2$, boiling at 214° C. (417° F.) to 218° C. (424.4° F.), and *phlorol*, $C_8H_{10}O_1$, boiling at 219° C. (426.2° F.).

The lower oily layer which forms in the distillate from wood-tar is treated with potassium carbonate to neutralize the acid present. Fractional distillation is now resorted to, with alternate treatment of the distillate with sulphuric acid and solution of potassa to separate impurities; the liquid is finally distilled, and the portion coming over between 205° C. (401° F.) and 220° C. (428° F.) is considered to be creasote. Nearly all of the liquid sold for and labelled "creasote" in the market is impure carbolic acid or coal-tar creasote. It may be distinguished from true wood creasote by the tests given below The odor of each is distinctive and characteristic.

Creasotum. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Other Solvents.
An almost colorless or yellowish, strongly refractive, oily liquid, turning to reddish-yellow or brown by exposure to light. It begins to boil near 200° C. (392° F.), and most of it distils over between 205° and 220° C. (401°–428° F.). When cooled to —20° C. (—4° F.) it becomes thick, but does not solidify. It is inflammable, burning with a luminous, smoky flame. When applied to the skin, it produces a white stain.	Penetrating, smoky odor; burning, caustic taste; neutral reaction. Sp. gr. 1.035 to 1.085.	Cold. 80 parts to a somewhat turbid liquid. Boiling. 12 parts.	Dissolves, in all proportions, in absolute alcohol, ether, chloroform, benzin, disulphide of carbon or acetic acid.

TESTS FOR IDENTITY.

Creasote may be distinguished from carbolic acid by the following tests. Creasote does not coagulate albumen or collodion. If 1 volume of Creasote be mixed with 1 volume of glycerin, a nearly clear mixture will result, from which the Creasote will be separated by the addition of 1 or more volumes of water. On adding to 10 C.c. of a 1 per cent. aqueous solution of Creasote 1 drop of test-solution of ferric chloride, the liquid acquires a violet-blue tint, which rapidly changes to greenish and brown, with formation, usually, of a brown precipitate.

Uses.—Creasote is a powerful antiseptic. It is used as a caustic application, and is frequently applied upon cotton to exposed nerves in teeth, when it acts as a local anæsthetic. It is also hæmostatic when applied to bleeding surfaces. In the form of creasote water it is used internally to check nausea. When taken internally, undiluted, and in large doses, it is a powerful poison. The administration of mucilaginous drinks, and the prompt evacuation of the stomach by the stomach-pump, would be the best treatment, no antidote to poisoning by creasote being known.

Officinal Preparation.

Aqua Creasoti . . One per cent. aqueous solution of creasote (see page 250). Dose, one to two fluidrachms.
Creasote Water.

Unofficinal Products of the Destructive Distillation of Cellulin and Allied Substances.

Acetone, C_3H_6O, = 58. A colorless, limpid liquid, of a peculiar ethereal odor and a burning taste. It is an excellent solvent for nearly all resins, gums, camphor, and fats. Acetone occurs largely in some varieties of wood spirit, and is a constant product of the dry distillation of acetates; it is also obtained from the residue left after manufacturing aniline by the distillation of nitrobenzene with acetic acid and iron.

Methylic Alcohol, CH_4O, = 32. It occurs among the products of the dry distillation of wood. The watery liquid is separated from the tar and distilled; then the first portion of the distillate is rectified over slaked lime, so as to remove acid, etc., and the product treated with sulphuric acid to remove tar and neutralize ammonia and methylamine, and, lastly, redistilled. It is a colorless, limpid liquid, of a peculiar odor, resembling alcohol and acetic ether, and of a warm taste. It is a good solvent for volatile oils, fats, and many resins.

Oleum Cadini.
Oil of Cade. An empyreumatic, dark brown, tar-like liquid, obtained from the wood of *Juniperus Oxycedrus*, and imported from the south of France. It is used as a local application in skin diseases.

Products resulting from the Natural Decomposition of Cellulin and Lignin and their Derivatives.

Coal is fossil fuel, which is found in the earth at various depths, and which has been formed by the decomposition of the cellulin, lignin, and other constituents of vegetable matter under the changing influences of moisture, temperature, and pressure to which it is subjected. The differences in the structure and composition of coal are undoubtedly due to the variations in these influences, as well as to the alterations in the character of the vegetable substances.

Coal-Tar.—Many valuable compounds have been contributed by recent researches to the arts and medicine from this formerly useless by-product. Coal-tar is a residue left after the dry distillation of bituminous coal in the process for making illuminating gas (see page 89). It is a very complex substance: its composition varies considerably with the temperature at which the distillation of the coal is effected, the yield of solid bodies and of gases being larger when the temperature is higher, while at a lower temperature the liquid portion of the tar is in increased amount. When coal-tar is submitted to distillation and rectification, it yields a brown, oily liquid, known technically as *light oil*, and consisting of benzol, toluol, etc.; then a black liquid, *dead oil*, is obtained, which contains aniline, naphthalin, phenol, etc.; the residue in the still is pitch, sometimes called *asphalt*. The products may be arranged in three classes.

1. *Solids.*—Naphthalin, $C_{10}H_8$, methyl-naphthalin, $C_{11}H_{10}$, acetyl-naphthalin and diphenyl, $C_{12}H_{10}$, fluoren, $C_{13}H_{10}$, anthracen and phenanthren, $C_{14}H_{10}$, fluoranthen, $C_{15}H_{10}$, methyl-anthracen, $C_{15}H_{12}$, reten, $C_{16}H_{12}$, chrysen, $C_{18}H_{12}$, pyren, $C_{16}H_{10}$, and carbazol, $C_{16}H_{11}N$.

2. *Liquids.*—These may be neutral hydrocarbons, acids, and ethers of the same, or bases. The *neutral hydrocarbons* are benzol, C_6H_6, toluol, C_7H_8, methyl-toluol and iso-xylol, C_8H_{10}, pseudocumol and mesitylen, C_9H_{12}, and cymol, $C_{10}H_{14}$. The *acid constituents* are phenol, C_6H_6O, kresol, orthokresol, parakresol, and metakresol, C_7H_8O, phlorol, $C_8H_{10}O$, rosolic acid, $C_{20}H_{16}O_3$, pyrocatechin, $C_6H_6O_2$, and kreosot, consisting of the methyl ethers of pyrocatechin and its homologues, $C_7H_8O_2$, $C_8H_{10}O_2$, and $C_9H_{12}O_2$. There are also present, probably in combination with the ammonia of the ammoniacal liquor, acetic, butyric, carbonic, hydrocyanic, sulphocyanic, and hydrosulphuric acids. The *bases* are ammonia, NH_3, methylamine, CH_3,NH_2, ethylamine, C_2H_5,NH_2, phenylamine, C_6H_5,NH_2, pyridine, C_5H_5N, picoline, C_6H_7N, lutidine, C_7H_9N, collidine, $C_8H_{11}N$, leukoline, C_9H_7N, iridoline, $C_{10}H_9N$, kryptidine, $C_{11}H_{11}N$, acridine, $C_{12}H_9N$, coridine, $C_{10}H_{15}N$, rubidine, $C_{11}H_{17}N$, and viridine, $C_{12}H_{19}N$.

3. *Gases.*—(*a.*) *Illuminating gases.* Acetylen, C_2H_2, ethylen, C_2H_4, propylen, C_3H_6, butylen, C_4H_8, allylen, C_3H_4, crotonylen, C_4H_6, teren, C_5H_8, and vapors of benzol, C_6H_6, styrolene, C_8H_8, naphthalin, $C_{10}H_8$, methyl-naphthalin, $C_{11}H_{10}$, fluoren, $C_{13}H_{10}$, fluoranthen, $C_{15}H_{10}$, propyl, $(C_3H_7)_2$, and butyl, $(C_4H_9)_2$.

(*b.*) *Heating and diluting gases.* Hydrogen, H_2, marsh-gas (methane), CH_4, and carbon monoxide, CO.

(*c.*) *Impurities.* Carbon dioxide, CO_2, ammonia, NH_3, cyanogen, $(CN)_2$, methyl-cyanide, CH_3,CN, sulphocyanic acid, CN,SH, hydrogen sulphide, H_2S, carbon disulphide, CS_2, carbon oxysulphide, COS, and nitrogen, N_2.

OLEUM SUCCINI. *U.S.* Oil of Amber.

A volatile oil obtained by the destructive distillation of Amber, and purified by subsequent rectification.

Amber is a fossil resin of an extinct coniferous wood, found principally upon the Baltic coast. By destructive distillation an acid liquor

containing succinic acid is produced, together with crude oil of amber; the latter is redistilled, and rectified oil of amber is the product. It is a pale yellow liquid, having an empyreumatic odor and a warm, acrid taste. Sp. gr. 0.920. It is soluble in alcohol, and when mixed with fuming nitric acid acquires a red color and is subsequently converted into a brown resinous mass known as *artificial musk.*

ACIDUM CARBOLICUM CRUDUM. *U. S.* Crude Carbolic Acid.

A liquid obtained during the distillation of coal-tar between the temperatures of 170° and 190° C. (338° and 374° F.), and containing Carbolic and Cresylic Acids in variable proportions, together with other substances.

Preparation.—That portion of the heavy oil obtained by distilling coal-tar which comes over between 165° C. (329° F.) and 190° C. (374° F.) is technically called "dead oil," which name was given to this fraction of the crude distillate because it was formerly believed to have no value. When "dead oil" is redistilled, the product is crude carbolic acid: if the latter is redistilled, the first distillate is principally water, until the temperature of 165° C. (329° F.) is reached. From this point to 185° C. (365° F.) nearly pure and crystallizable phenol, or carbolic acid, will distil over, whilst the portion received between the temperatures of 185° C. (365° F.) and 195° C. (383° F.) will not crystallize, but will consist mainly of cresol and other phenols. At temperatures from 195° C. (383° F.) to 211° C. (411.8° F.) cresol, C_7H_8O, and xylenol, $C_8H_{10}O$, are obtained. Crude carbolic acid, therefore, according to the officinal boiling points, consists of phenol, with small quantities of cresol and other phenols. According to Dr. Squibb, however, it is principally the second distillate above mentioned, from 185° C. (365° F.) to 195° C. (383° F.), and consists mainly of cresol.

Acidum Carbolicum Crudum. *U. S.*	Tests for Identity.
A nearly colorless or reddish-brown liquid, of a strongly empyreumatic and disagreeable odor; having a benumbing, blanching, and caustic effect on the skin or mucous membrane, and a neutral reaction.	Bromine water produces, in an aqueous solution of Carbolic or Cresylic Acid, a white, flocculent precipitate. The crude acid should not dissolve in less than 15 parts of water, nor should the solution have an alkaline reaction. If 50 volumes of the crude acid be diluted with warm water to measure 1000 volumes, and the mixture well shaken, cooled, and allowed to separate, the amount of undissolved impurities should not exceed 5 volumes, or 10 per cent. by volume of the crude acid. The amount of water in a solution of crude acid may be determined by agitating the solution, in a graduated cylinder, with an equal volume of chloroform. After standing, the upper layer consists of the water contained in the mixture.

Uses.—Crude carbolic acid is a powerful antiseptic, and is largely used in hospitals and in domestic practice as a disinfectant. It is well adapted for this purpose; and if it is of the officinal quality, it is superior to pure carbolic acid, as cresol is known to be more energetic than phenol. For profuse use, two parts of crude carbolic acid should be thoroughly agitated with eighty-eight parts of water, and, after the mixture has been allowed to stand a short time, the solution is filtered.

ACIDUM CARBOLICUM. *U.S.* Carbolic Acid.

C_6H_5HO; 94. [PHENOL.]

A product of the distillation of coal-tar between the temperatures of 180° and 190° C. (356° and 374° F.).

Preparation.—This valuable product is properly termed phenol, and it belongs to a well-marked class of hydrocarbons of which it is the type. It is made by distilling crude carbolic acid, and separating and purifying the distillate by repeated crystallizations. When perfectly pure, carbolic acid is devoid of the odor of creasote, but it has a peculiar aromatic odor, which is not disagreeable.

Acidum Carbolicum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Colorless, interlaced, needle-shaped crystals, sometimes acquiring a pinkish tint, deliquescent on exposure. It produces a benumbing, blanching, and caustic effect on the skin. The crystals melt at 36°–42° C. (96.8°–107.6° F.), and boil at 181°–186° C. (357.8°–366.8° F.),—the higher melting and the lower boiling points being those of the pure and anhydrous acid. On continued heating the acid is completely volatilized.	Distinctive, slightly aromatic odor resembling creasote; when diluted, a sweetish taste, with a slightly burning after-taste; neutral reaction.	20 parts. 100 parts of the crystals are liquefied by the addition of about 5 parts of water; this liquid is rendered turbid by the further addition of water, until 2000 parts have been added, when a stable and clear solution is formed.	Very soluble.	Very soluble in ether, chloroform, benzol, disulphide of carbon, commercial and absolute glycerin, fixed and volatile oils.

Tests for Identity.	Impurities.	Tests for Impurities.
Carbolic Acid coagulates albumen or collodion (difference from creasote). Its aqueous solution forms a white precipitate with bromine water. On adding to 10 C.c. of a 1 per cent. aqueous solution of the Acid 1 drop of test-solution of ferric chloride, the liquid acquires a violet-blue color which is permanent, the color thus caused by creasote rapidly changing to greenish and brown, with formation, usually, of a brown precipitate.	Creasote and Cresylic Acid.	One volume of the liquefied Acid, containing 5 per cent. of water, forms, with 1 volume of glycerin, a clear mixture which is not rendered turbid by the addition of 3 volumes of water.
	Water.	The amount of water contained in a solution of the Acid may be determined by agitating the solution, in a graduated cylinder, with an equal volume of chloroform. After standing, the upper layer consists of the water contained in the mixture.

Carbolic acid, as it is found in commerce, varies in the proportion of water that it contains, and a slight variation materially alters the melting and boiling points. The congealing point is regarded by Dr. Squibb as a better test of the quantity of real phenol present in a sample than the

melting point; the congealing point should be between 29.4° C. (85° F.) and 38.5° C. (101° F.), and is ascertained by melting some of the acid in a beaker and stirring with a thermometer until it completely crystallizes. The mercury rises in the thermometer and remains constant for a considerable length of time during the congelation. The solubility in water, 5 per cent., given in the officinal test has been proved to be incorrect; pure carbolic acid of the quality now easily attainable will dissolve in water to the extent of 26 per cent.: the discrepancy is accounted for by the improved quality of the phenol now in the market. The officinal chloroform test to show the presence of water is not reliable for fine indications. Whilst carbolic acid is soluble in chloroform, so that it can be abstracted from its aqueous solution, water itself is sufficiently soluble in chloroform to vitiate the results.

Uses.—Pure carbolic acid is largely used as an antiseptic; it is often found of two qualities, known as "No. 1 gold label" and "No. 2;" the former should be exclusively used in antiseptic surgery and for making all preparations intended for internal use. It is a good practice to add one fluidounce of water to a pound of carbolic acid in the bottle, and warm the whole up on a water-bath until the solution is effected. The contents may then be used in a liquid form without the troublesome necessity of weighing the crystals.

Officinal Preparation.

Unguentum Acidi Carbolici . 10 parts of carbolic acid; 90 parts of ointment. (See Ointment of Carbolic Acid. Unguenta.)

ACIDUM SALICYLICUM. *U.S.* Salicylic Acid.

$HC_7H_5O_3$; 138.

Preparation.—Although salicylic acid may be obtained from several natural sources, it is now obtained, according to Kolbe's patent, by treating sodium phenol (or carbolate) with carbon dioxide. For this purpose, the most concentrated caustic soda solution is evaporated with the corresponding amount of phenol to a dry powder; this is then heated to 100° C. (212° F.), while a stream of dry carbon dioxide is passed over it. The temperature is gradually raised to 180° C. (356° F.), and increased to 220° C. (428° F.) as soon as phenol distils over, and finally raised to 250° C. (482° F.), until no more phenol distils. In the retort, the half of the phenol used remains as sodium salicylate, while the other half has distilled over unchanged. The reaction is as follows:

$$\underset{\text{Sodium Phenol.}}{2NaC_6H_5O} + \underset{\text{Carbon Dioxide.}}{CO_2} = \underset{\text{Phenol.}}{C_6H_6O} + \underset{\text{Normal Sodium Salicylate.}}{Na_2C_7H_4O_3}.$$

The sodium salt thus obtained is dissolved in water, decomposed by hydrochloric acid, and the salicylic acid filtered off, washed, and crystallized out of hot water, or purified by sublimation in a current of superheated steam or dialyzed.

Acidum Salicylicum. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Fine, white, light, prismatic, needle-shaped crystals, permanent in the air, free from odor of carbolic acid.	Having sometimes a slight aromatic odor; sweetish and slightly acrid taste; acid reaction.	Cold. 450 parts. Boiling. 14 parts.	Cold. 2.5 parts. Boiling. Very soluble.	Soluble in 2 parts of ether, in 2 parts of absolute alcohol, in 3.5 parts of amylic alcohol, and in 80 parts of chloroform.

Tests for Identity.	Impurities.	Tests for Impurities.
When heated to about 175° C. (347° F.) the crystals melt, and at about 200° C. (392° F.) they begin to sublime; at a higher temperature they are volatilized and decomposed with odor of carbolic acid. The aqueous solution is colored intensely violet-red by test-solution of ferric chloride.	Hydrochloric Acid.	A solution of 1 part of Salicylic Acid in 10 parts of alcohol, mixed with a few drops of nitric acid, should not become turbid upon the addition of a few drops of test-solution of nitrate of silver.
	Organic Impurities and Iron.	A saturated solution of the acid in absolute alcohol, when allowed to evaporate spontaneously in an atmosphere free from dust, should leave a perfectly white crystalline residue, without a trace of color at the points of the crystals.
	Foreign Organic Matter.	On agitating a portion of Salicylic Acid with 15 parts of concentrated sulphuric acid, no color should be imparted to the latter within fifteen minutes.
	Carbolic Acid.	If 5 C.c. of a saturated aqueous solution of Salicylic Acid be poured into a test-tube, into which has been introduced, shortly before, a crystal of chlorate of potassium and 2 C.c. of hydrochloric acid, and some water of ammonia be now carefully poured on top, the latter should not assume a reddish or brownish tint.

Uses.—Salicylic acid is a valuable new remedy. It is used as an antipyretic, in doses of seventy-five grains, given in divided doses, until the temperature is lowered. Its principal use is in rheumatism and gout, the dose being ten grains. Three salts of the acid are officinal,—salicylates of sodium, lithium, and physostigmine. The former is a very valuable salt, and is generally relied upon now for the internal administration of the acid.

Unofficinal Products of the Destructive Distillation of Coal-Tar.

Aniline, C_6H_7N. Prepared by treating an alcoholic solution of nitrobenzol with ammonia and hydrogen sulphide until a precipitation of sulphur takes place. The brown liquid is again saturated with hydrogen sulphide until sulphur ceases to be deposited. The liquid is then mixed with excess of acid, filtered, boiled, and then distilled with excess of caustic potash. A colorless, limpid, oily, inflammable liquid, of a peculiar wine-like odor and burning, aromatic taste. It is used chiefly in the preparation of aniline dyes.

Antipyrin, $C_{20}H_{18}N_4O_2$. A compound made by heating methyl-oxychinizin with an excess of phenyl-hydrazin to boiling, and collecting the powder. It forms a white, crystalline powder which is very freely soluble in cold water. It gives an intense red coloration with ferric chloride. Dose, 15 to 40 grains.

Benzol, C_6H_6. Obtained by subjecting coal-tar to fractional distillation, agitating the oily distillate with potassa solution, and rectifying. A thin, colorless, very inflammable liquid, having an aromatic odor and a sweetish, aromatic taste. Nearly insoluble in water; soluble in alcohol, ether, etc. It is chiefly employed in the manufacture of nitrobenzol and aniline products, and is a valuable solvent.

Unofficinal Products of the Destructive Distillation of Coal-Tar.—(*Continued.*)

Chinoline, C_9H_7N.	By mixing aniline, nitrobenzol, glycerin, and sulphuric acid, heating, then diluting with water and distilling to drive off nitrobenzol; on rendering the residue alkaline and distilling with steam, chinoline passes over. A colorless, mobile liquid, having a pungent, somewhat bitter-almond odor, and a bitter taste. Sp. gr. 1.081.
Eosin, $C_{20}H_8Br_4O_5$.	A bronze-colored, crystalline powder, obtained from the action of phthalic acid upon phenols. Eosin is largely used as a dye, and for making a brilliant red ink, by dissolving 5 grains in a fluidounce of water in which 10 grains of acacia have been dissolved.
Fuchsin (Rosaniline), $C_{20}H_{19}N_3$.	A non-volatile, colorless, bitter substance, produced whenever a mixture of aniline and toluidine is heated to about 180° C. with an oxidizing agent of moderate power, as, for example, arsenic acid. The solutions of some of its acid salts are used largely for dyeing silk and wool, the color being a magnificent crimson.
Ichthyol.	A tarry-looking substance, obtained from a brownish mineral, containing animal residues of fish, etc., found in Sufeld, in Tyrol. Purified by distillation and treatment with sulphuric acid. Ichthyol has an herb-like odor, is faintly alkaline, and contains 10 per cent. of sulphur in the form of a sulpho-acid. Used for skin diseases.
Naphthalin, $C_{10}H_8$.	Obtained by distilling coal-tar oil and collecting that portion by itself which passes over between 170° and 200° C. (338° and 392° F.). The dark-colored product is purified by resubliming it several times. It occurs in brilliant, white, crystalline plates, with a tarry odor. Volatile like camphor. Soluble in alcohol. Used as a stimulant and antiseptic, and for destroying low animal and vegetable organisms.
Naphthol, $C_{10}H_8O$.	A phenol-like body, obtained from naphthalin. White, shining, rhombic, tabular crystals, without odor or color. Soluble in spirit and fat. Used chiefly as an antiseptic and disinfectant.
Phenol-phthalein, $C_{20}H_{14}O_4$.	Prepared by digesting 10 p. phenol, 5 p. phthalic anhydride, and 4 p. concentrated sulphuric acid for several hours at 120°–130° C., then boiling the residuum with water to remove soluble matter. The resinous substance so left is boiled in benzol. It is a yellowish-brown powder. The test-solution used as an indicator is prepared by dissolving 1 p. phenol-phthalein in 30 p. 90 per cent. alcohol.
Phthalic Acid, $C_8H_6O_4$.	Produced by heating salicylic acid with a mixture of sulphuric acid and potassium ferrocyanide, and, when the reaction is ended, treating the resulting mass with ether, which extracts the phthalic acid. It occurs in nacreous laminæ or shining monoclinic prisms. Soluble in alcohol, ether, and benzol.
Picric Acid, $C_6H_3N_3O_7$.	Prepared by dissolving crystallized carbolic acid in strong sulphuric acid, and adding nitric acid to the resultant sulphophenic acid. It is purified by neutralizing with sodium carbonate and filtering to separate resin, then adding to the filtrate excess of sodium carbonate, when sodium picrate is precipitated. This salt is decomposed by sulphuric acid, and the picric acid crystallized. It is much employed for dyeing wool and silk yellow, also for staining wood.
Resorcin, $C_6H_6O_2$.	Prepared by carefully fusing an alcoholic extract of ammoniac with three times its weight of potassa until a homogeneous mass results, then dissolving it in water and slightly acidulating with sulphuric acid, filtering, and agitating with ether. On evaporating the ether, impure resorcin is left; this is purified by dissolving it in ether, distilling, and crystallizing. Colorless, short, rhombic prisms or plates, of a neutral reaction and an unpleasant, sweet, and somewhat acrid taste. Freely soluble in water, alcohol, and ether. Used as an antiseptic, and has been used for cholera. Dose, internally, 7 to 10 grains in solution.
Rosolic Acid (Corallin).	Obtained by acting on commercial phenol with oxalic and sulphuric acids.
Sulpho-Carbolic Acid (Sulphophenic Acid). $C_6H_6SO_4$.	This substance is produced by the direct action of concentrated sulphuric acid upon carbolic acid. It is soluble in water and in alcohol. The acid is a decided antiseptic, and its solutions coagulate albumen.
Tropæolin.	Dye-color used as an indicator in volumetric analysis.
Xylol, C_8H_{10}.	By treating the oily liquid separating from diluted crude wood-spirit and from the light oil of wood-tar or coal-tar, first with sulphuric acid, and afterwards subjecting these liquids to fractional distillation, collecting only that portion which distils between 136° and 140° C. (277° and 286° F.). A thin, colorless, oily liquid, resembling benzol in odor. It has a burning taste. Soluble in alcohol.

CHAPTER L.

AMYLACEOUS AND MUCILAGINOUS PRINCIPLES AND THEIR PRODUCTS.

STARCH has the same chemical composition as cellulin, $C_6H_{10}O_5$, and is closely allied to it in its properties. Starch is stored up in plants in anticipation of future usefulness in the formation of their cell-walls, growing tissues, or other constituents. It exists in the form of granules, which in young and small plants appear to be always spherical; their shape subsequently becomes ovoid, lenticular, polyhedral, or irregular, and it is possible to identify the varieties of starch obtained from various plants, with the aid of the microscope, by the shape and size of the granules.

The granules consist of layers of different densities, arranged concentrically around a central point termed the hilum, which is usually at one end of the granule. Wheat starch is officinal.

AMYLUM. *U.S.* **Starch.**

The fecula of the seed of *Triticum vulgare* Villars (Nat. Ord. *Graminaceæ*).

Starch is present in many drugs, and is an important constituent of many vegetable foods.

Preparation.—Starch is made from potatoes by first grating them, and then pressing the soft mass upon a sieve, which separates the cellular substances and permits the starch granules to fall through. These must be thoroughly washed, the quality of starch depending largely upon the purity of the water that is used in washing it. In making starch from wheat or corn the gluten must be separated. This is generally done by permitting it to become sour and disintegrated through acetous fermentation; stopping the fermentation before the starch is affected. Upon the small scale, starch may be made from wheat flour by placing it in a fine linen bag and kneading it whilst a small stream of water is trickling on it. The starch is carried off with the water, whilst the gluten remains as a soft mass in the bag.

Starch by the action of diluted acids, diastase, or heat is converted into *dextrin*, a substance resembling gum in appearance and properties Dextrin is largely dissolved by water, hot or cold, and forms a mucilaginous solution, from which it is precipitated by alcohol. Large quantities of dextrin are now made both here and abroad, and employed for various purposes in the arts, under the name of *artificial gum* or *British gum*. It is found in the market in the form of a white, brilliant powder, and in small masses or fragments resembling natural gum. It may be distinguished from gum arabic by the taste and smell of potato oil which it always possesses.

Starch is completely dissolved by calcium and zinc chlorides in concentrated solution. *Inulin*, $C_{12}H_{20}O_{10}$, is a substance closely allied to starch. It is found particularly in the plants belonging to the order Compositæ, as Inula, Taraxacum, etc. It has also been found, according to Kraus, in plants of the Campanulaceæ, Goodeniaceæ, Lobeliaceæ, and Stylidæ. It differs from starch in the following particulars: it is colored yellow by iodine, does not gelatinize with water, and is not found in plants in the form of granules having concentric layers like starch.

Amylum. *U. S.*	Odor and Taste.	Solubility.		
		Water.	Alcohol.	Other Solvents.
In irregular, angular masses, which are easily reduced to powder of a white color. Under the microscope appearing as granules, mostly very minute, more or less lenticular in form, and indistinctly, concentrically striated.	Inodorous; tasteless.	Insoluble.	Insoluble.	Insoluble in ether.

Tests for Identity.

Triturated with cold water, it gives neither an acid nor an alkaline reaction with test-paper. When boiled with water, it yields a white jelly having a bluish tinge, which, when cool, acquires a deep blue color on the addition of test-solution of iodine.

Uses.—Starch was made officinal because it is used in making iodized starch and glycerite of starch. It is used externally as an absorbent, and is applied to the skin by dusting.

Officinal Preparations.

Amylum Iodatum . . Starch containing 5 per cent. of iodine (see page 426).
Iodised Starch.

Glyceritum Amyli . . Starch jelly, made with 10 parts of starch and 90 parts of glycerin
Glycerite of Starch. (see page 275).

Unofficinal Amylaceous Substances.

Acorn. From the genus *Quercus*. They contain besides starch a peculiar saccharine substance, *quercit*.

Bean. From *Faba vulgaris* and *Phaseolus vulgaris*.

Barley. *Hordeum distichum*. Contains 60 to 68 per cent. of starch, also gluten, gum, and sugar.

Canna. From the rhizome of *Canna edulis*. Nat. Ord. Marantaceæ, Cannæ. Indigenous to Peru and Brasil. The starch granules are very large, and exhibit a glistening or satiny appearance. It forms a cloudy but very tenacious jelly with boiling water.

Cassava. Tapioca. Manioc. From the root of *Manihot utilissima*. Nat. Ord. Euphorbiaceæ. Habitat, Tropical America. The starch granules are about half the size of the potato granules, in somewhat translucent pieces, inodorous, having an insipid taste.

Corn. From the seed of *Zea Mays*. Nat. Ord. Graminaceæ. Habitat, North America. The starch granules are irregularly angular, and about two-thirds as large as those of wheat starch.

Curcuma. Turmeric. From the rhizome of *Curcuma longa*. Nat. Ord. Zingiberaceæ. Habitat, Southern Asia, cult. The starch granules are rather larger than those of maranta.

Maranta. Arrowroot. From the rhizome of *Maranta arundinacea*. Nat. Ord. Marantaceæ. Indigenous to West Indies and Tropical America. Prepared by removing the scales from the rhizome, mashing and grinding in a mill until reduced to a pulp, then suspending this in water, and separating the fibrous portion, either by

Unofficinal Amylaceous Substances.—(*Continued.*)

	hand or sieve; lastly, washing thoroughly, and drying with a gentle heat. The yield is from 13 to 20 per cent. of fecula. It forms an opaque jelly with concentrated hydrochloric acid.
Oats.	From *Avena sativa*. Nat. Ord. Graminaceæ. Habitat, Asia, cult. The grain contains 64 to 66 per cent. of starch, besides protein compounds, fat, salts, etc.
Pea.	From *Pisum sativum*. It yields about 37 per cent. of starch.
Potato	From the tubers of *Solanum tuberosum*. Nat. Ord. Solanaceæ. Habitat, Europe and America. Prepared by drenching washed and rasped potatoes in a sieve with a continuous stream of cold water, allowing the liquid to stand for a short time, and washing repeatedly the granules which collect at the bottom of the liquid; lastly, drying carefully. The yield is about 20 per cent. It is largely used as an adulterant.
Sweet Potato.	From *Convolvulus Batatas*. The yield of starch is about 16 per cent.
Rice.	From *Oryza sativa*. Prepared by heating rice with weak soda-lye, which dissolves the nitrogenous impurities and leaves pure starch, then adding a solution of borax to facilitate the separation of the starch from the gluten. The yield is about 88 per cent.
Rye.	From *Secale cereale*. The yield of starch is about 64 per cent.
Sago.	From the pith of *Metroxylon Sagu*. Nat. Ord. Palmæ. Prepared by powdering the pith of the tree, washing with water to remove woody tissue and other impurities; lastly, drying carefully and granulating.

MALTUM. *U. S.* Malt.

The seed of *Hordeum distichum* Linné (Nat. Ord. *Graminaceæ*), caused to enter the incipient stage of germination by artificial means and dried.

Preparation.—When barley is steeped for two or three days in water, it swells, becomes somewhat tender, and the water is colored reddish brown. If the water is drained off, and the barley is spread about two feet thick upon a floor (a stone floor is generally used), it heats spontaneously, and germination begins, the radicle making its appearance first. The growth of the grain is partially stopped at this stage by spreading it more thinly, and turning it over for two days. It is then raked into heaps and allowed to stand a day, when it becomes hot, and it is subsequently thoroughly dried in a kiln by a slow, regulated heat. This is malt, and it differs in quality according as it is more or less soaked, drained, germinated, dried, or baked. It is distinguished by its color, being pale, amber, brown, or black malt, according to the degrees of heat used in drying it.

The object of converting grain into malt is to change the *starch*, naturally present in the grain, into *maltose*, a peculiar kind of sugar, and dextrin. This is effected through the presence of *diastase*, a peculiar and powerful ferment, which is developed during the partial germination to which the grain is subjected in malting. A portion of the starch is always left unchanged by the process of germination, its conversion into maltose being completed during the heating in the kiln.

The diastase which is developed is capable of converting into maltose much more starch than is contained in the grain in which it is produced: hence, if good malt be added to a certain quantity of unmalted grain, the starch in the latter may be also converted into maltose.

Malt seldom contains diastase in larger proportion than two parts in a thousand. It is obtained by bruising fresh malt, adding about half its weight of water, expressing strongly, treating the viscid liquid thus obtained with sufficient alcohol to destroy its viscidity, then separating the coagulated albumen, and adding a fresh portion of alcohol, which precipitates the diastase in an impure state. To render it pure, it must

be redissolved as often as three times in water, and precipitated by alcohol. Diastase is solid, white, tasteless, soluble in water and in weak alcohol, but insoluble in the latter fluid when concentrated. Though without action upon gum and sugar, it has the extraordinary property, when mixed, in the proportion of only one part to two thousand, with starch suspended in water, and maintained at a temperature of about 71.1° C. (160° F.), of converting that principle into dextrin and *maltose.*

Uses.—Although malt has been manufactured in large quantities for centuries for brewing purposes, it has only recently been employed in medicine, in the form of extracts of malt, malt foods, etc. (see Extractum Malti, page 385). Its usefulness in this connection is due to the fact that the amount of diastase present in good malt has the power of *rendering soluble, starchy substances which are taken into the stomach as food;* and good preparations of malt are not only easily-digested food-products themselves, but also actively aid in the digestion of other substances. Some of the commercial malt extracts consist of glucose colored with caramel, and slightly flavored with extract of malt.

Officinal Preparation.

Extractum Malti . Made by macerating and digesting 100 parts of malt, first with cold water, and then with water warmed to a temperature not exceeding 55° C. (131° F.), straining the mixture, and evaporating the strained liquid in a vacuum or at a low temperature to the consistence of thick honey (see page 385).
Extract of Malt.

CETRARIA. *U. S.* Cetraria. [Iceland Moss.]

Cetraria islandica Acharius (Nat. Ord. *Lichenes*).

This lichen is found in northern latitudes on both continents. It contains 70 per cent. of *lichenin*, $C_{12}H_{20}O_{10}$, a substance which is allied to starch, and which swells up when soaked in water; about 3 per cent. of *cetraric acid*, $C_{18}H_{16}O_8$, a very bitter crystalline body; *lichenstearic acid*, $C_{14}H_{34}O_3$; sugar, oxalic acid, fumaric acid, and cellulin.

Uses.—It is used as a demulcent and nutritive when made into a jelly or decoction.

Officinal Preparation.

Decoctum Cetrariæ. Made by macerating 5 parts of cetraria in 40 parts of water, expressing and throwing away the liquid (this is done to separate the bitter principle cetraric acid), then boiling the cetraria with 100 parts of water, straining, and making the product up to 100 parts. The bitter principle may be more effectually separated by boiling the cetraria with an alkaline solution (see page 298).
Decoction of Cetraria.

CHONDRUS. *U.S.* Chondrus. [Irish Moss.]

Chondrus crispus Lyngbye, and *Chondrus mammilosus* Greville (Nat. Ord. *Algæ*).

This alga grows in the Atlantic Ocean. It contains 70 per cent. of a mucilaginous principle, which has been termed *carrageenin.* This differs from *gum* by not precipitating with alcohol, from *starch* by not becoming blue upon the addition of iodine, and from *pectin* by not being precipitated by subacetate of lead.

Uses.—Chondrus is used principally to form a sick-diet jelly, one part being sufficient to form a jelly with sixty parts of water. It should be previously soaked in a small quantity of water, to dissolve adherent salts, and this water thrown away.

Gums and Mucilaginous Substances.

The proximate principle *arabin* (formerly termed gum) may be described as a vegetable substance, which forms with water a thick glutinous liquid, is insoluble in alcohol, and, when treated with nitric acid, is converted into mucic and oxalic acids. Three proximate principles are found in gums: 1. *Arabin*, or Arabic acid, $C_{12}H_{22}O_{11}$, the soluble form, found largely in acacia. 2. *Bassorin*, $C_{12}H_{20}O_{10}$, or insoluble gum, found in tragacanth. 3. *Cerasin* (insoluble), found in cherry gum.

Some exudations are composed of both soluble and insoluble gum. Vegetable mucilage and insoluble gum appear to be "degradation products," or compounds produced by subsequent changes in the substance of the organized structures of plants, which are of no further use to the plant in the work of building up new cell-walls. *Gums* differ from *starch*, or *cellulin*, by being soluble in water, or by swelling up in contact with it. They differ from sugars by being incapable of vinous fermentation with yeast. There will be frequent occasion to refer to the uses of gum in the subsequent chapters.

ACACIA. *U.S.* Acacia. [Gum Arabic.]

A gummy exudation from *Acacia Verek* Guillemin et Perrottet, and from other species of *Acacia* (Nat. Ord. *Leguminosæ*, *Mimoseæ*).

This valuable gum consists mainly of arabic acid, or arabin, combined with lime, potassa, or magnesium, and hence it may be called calcium, potassium, or magnesium arabate. It is in roundish or amorphous pieces, or irregular fragments, of various sizes, more or less transparent, hard, brittle, pulverizable, and breaking with a shining fracture. It is usually white, or yellowish white, but frequently presents different shades of red, and is sometimes of a deep-orange or brownish color. It is bleached by exposure to the sun. In powder it is always white. It is inodorous, has a feeble, slightly sweetish taste, and when pure dissolves wholly in the mouth. The sp. gr. varies from 1.31 to 1.525 for the dried gum.

The gum dissolves at ordinary temperatures slowly, in an equal weight of water, forming a thick glutinous liquid of distinctly acid reaction. It is insoluble in alcohol, ether, and the oils. One hundred parts of diluted alcohol containing 22 per cent. of alcohol by volume dissolve fifty-seven parts of gum, diluted alcohol containing 40 per cent. of alcohol takes up ten parts, whilst 50 per cent. alcohol dissolves only four parts.

Neutral lead acetate does not precipitate its aqueous solution, but the basic acetate forms even in a very dilute solution a precipitate. Soluble silicates, borates, and ferric salts render solution of gum turbid, or thicken it to a jelly. No alteration is produced by silver salts, mercuric

chloride, or iodine. Gum dissolves in an ammoniacal solution of cupric oxide.

Uses.—In pharmacy, acacia is extensively used for the suspension of insoluble substances in water, and for the formation of pills and troches. Two kinds of powdered acacia are used, one a coarse powder called *granulated*, the other *finely dusted*. The granulated dissolves more readily in water, because it has lost during desiccation only a part of its moisture, whilst in preparing the "finely dusted" powder the high heat necessarily used to dry it thoroughly, drives off nearly all the water. Its easy solubility and its absence of tendency to form "lumps" cause the coarse powder to be preferred for solutions, emulsions, etc.

Officinal Preparations.

Mucilago Acaciæ . . . Made by dissolving 34 parts of acacia in 66 parts of cold water, preferably made by circulatory solution (see Fig. 287, page 217).
Mucilage of Acacia.

Syrupus Acaciæ . . . Made by mixing 25 parts of mucilage of acacia with 75 parts of syrup (see page 259).
Syrup of Acacia.

The mucilage must be freshly made and free from acidity. The syrup does not keep well.

TRAGACANTHA. *U. S.* Tragacanth.

A gummy exudation from *Astragalus gummifer* Labillardière, and from other species of *Astragalus* (Nat. Ord. *Leguminosæ*, *Papilionaceæ*).

This gum upon analysis was found to consist of 33 per cent. of bassorin, or insoluble gum, 53 per cent. of soluble gum (not arabin), 11 per cent. of water, and 3 per cent. of impurities.

Tragacanth is either in flaky, leaf-like pieces, or in tortuous vermicular filaments, of a whitish color, somewhat translucent, and resembling horn in appearance. It is hard and more or less fragile, but difficult of pulverization, unless exposed to a freezing temperature, or thoroughly dried, and powdered in a heated mortar. Tragacanth has no smell, and very little taste. Its sp. gr. is 1.384. Introduced into water, it absorbs a certain proportion of that liquid, swells very much, and forms a soft adhesive paste, but does not dissolve. If agitated with an additional quantity of water, this paste forms a uniform mixture; but in the course of one or two days the greater part separates, and is deposited, leaving a portion dissolved in the supernatant fluid. The gelatinous mass is tinged blue by test-solution of iodine, and the fluid portion is not precipitated on the addition of alcohol. Tragacanth is wholly insoluble in alcohol. It appears to be composed of two different constituents, one soluble in water and resembling acacia, the other swelling in water, but not dissolving. The former differs from acacia in affording no precipitate with potassium silicate or ferric chloride.

Officinal Preparation.

Mucilago Tragacanthæ . . Made by mixing 18 parts of glycerin with 76 parts of water, heating to boiling, adding 6 parts of tragacanth, macerating, making the weight up to 100 parts, and then straining forcibly through muslin (see page 270).
Mucilage of Tragacanth.

ULMUS. *U. S.* Elm. [Slippery Elm.]

The inner bark of *Ulmus fulva* Michaux (Nat. Ord. *Urticaceæ*, *Ulmeæ*).

This bark contains a mucilage which is capable of being precipitated by alcohol and lead acetate from its aqueous solution. It is much used as a demulcent.

Officinal Preparation.

Mucilago Ulmi . . Made by macerating 6 parts of dried and sliced elm in 100 parts of boiling water (see page 271).
Mucilage of Elm.

SASSAFRAS MEDULLA. *U. S.* Sassafras Pith.

The pith of *Sassafras officinalis* Nees (Nat. Ord. *Lauraceæ*).

This pith contains a delicate mucilage, which is not precipitated from its aqueous solution by alcohol. It is used for making the officinal mucilage, which is principally employed as an eye-wash.

Officinal Preparation.

Mucilago Sassafras Medullæ . Made by macerating 2 parts of sassafras pith in 100 parts of water and straining (see page 270).
Mucilage of Sassafras Pith.

CYDONIUM. *U. S.* Cydonium. [Quince Seed.]

The seed of *Cydonia vulgaris* Persoon (Nat. Ord. *Rosaceæ*, *Pomeæ*).

Quince seed contains about 20 per cent. of a peculiar mucilage, which is not precipitated by borax from its aqueous solution. The officinal mucilage is used in injections and eye-washes.

Officinal Preparation.

Mucilago Cydonii . . . . Made by macerating 2 parts of cydonium in 100 parts of distilled water, and draining the liquid without pressure through muslin (see page 270).
Mucilage of Cydonium.

ALTHÆA. *U. S.* Althæa. [Marshmallow.]

The root of *Althæa officinalis* Linné (Nat. Ord. *Malvaceæ*).

This root, which is generally imported from Europe, contains a large quantity of mucilage, $C_{12}H_{20}O_{10}$, associated with *asparagin*, sugar, and starch. It is used solely as a demulcent.

Officinal Preparation.

Syrupus Althææ . . This syrup is made by pouring 60 parts of cold water on 4 parts of cut althæa, macerating for one hour, then draining through flannel without expressing; 60 parts of sugar are added to the liquid and dissolved by agitation without heat (see page 260).
Syrup of Althæa.

LINUM. *U. S.* Flaxseed. [Linseed.]

The seed of *Linum usitatissimum* Linné (Nat. Ord. *Linaceæ*).

Flaxseed contains 15 per cent. of mucilage, $C_{12}H_{20}O_{10}$, in the epithelium, and from 20 to 35 per cent. of fixed oil in the nucleus, besides resin, sugar, wax, etc. The mucilage is soluble in water, but more readily in hot water, forming a thick, viscid liquid. Alcohol and subacetate of lead precipitate it from its aqueous solution. The mucilage

is an important constituent; the seed is used in its unground state for making a demulcent infusion. Ground flaxseed is very useful to the pharmacist for making lutes, and, medicinally, it is used for making poultices. The fixed oil present is very valuable because of its drying properties. (See Oleum Lini.)

Unofficinal Mucilaginous Substances.

Bael-fruit.	The dried, half-ripe fruit of *Ægle Marmelos*. Nat. Ord. Aurantiaceæ. Habitat, Himalaya Mountains. Used principally in dysentery. Dose of fluid extract, 1 to 2 fluidrachms.
Baobab.	From *Adansonia digitata*. Nat. Ord. Sterculiaceæ. Habitat, Tropical Africa. Used as a tonic.
Benne Leaves.	From *Sesamum Indicum*. Nat. Ord. Pedaliaceæ. Habitat, India. Used as a stimulant.
Blue-weed.	From *Echium vulgare*. Habitat, Europe. Used chiefly as an emollient and protective.
Borage.	From *Borago officinalis*. Nat. Ord. Boraginaceæ. Habitat, Southern Europe. Used chiefly as an emollient and protective.
Cashew-nut.	From *Anacardium occidentale*. Nat. Ord. Terebinthaceæ. Habitat, Tropical America. Used externally and as a vermifuge.
Comfrey-root.	The root of *Symphytum officinale*. Nat. Ord. Boraginaceæ. Habitat, Europe. Used as a demulcent and astringent.
Evening Primrose.	From *Œnothera biennis*. Nat. Ord. Onagraceæ. Habitat, North America.
Fenugreek.	The seeds of *Trigonella Fœnum-græcum*. Nat. Ord. Leguminosæ. Habitat, Western Asia. Used as an emollient.
Hog Gum.	From *Rhus metopium*. Habitat, South America. Used as a demulcent.
Hound's Tongue.	From *Cynoglossum officinale*. Habitat, Europe and United States. Used as an emollient and protective.
Jujube Berries.	The fruit of *Zizyphus vulgaris*. Nat. Ord. Rhamnaceæ. Habitat, Asia Minor. Used as a laxative.
Laminaria.	From *Laminaria Cloustoni*. Nat. Ord. Algæ. Habitat, North Atlantic Ocean.
Lungwort.	From *Pulmonaria officinalis*. Habitat, Europe.
Maidenhair.	The fronds of *Adiantum Capillus-Veneris*. Nat. Ord. Filices. Used as a demulcent and stimulant.
Mezquite Gum.	From *Algarobia glandulosa*. Habitat, Texas.
Mullein.	The leaves and flowers of *Verbascum Thapsus*. Nat. Ord. Scrophulariaceæ. Habitat, North America. Used as a demulcent.
Okra.	From *Hibiscus esculentus*. Habitat, Africa.
Salep.	From the tubers of *Orchis mascula*. Is very mucilaginous, only four grains being sufficient to make one fluidounce of water gelatinous.
Virginia Lungwort.	From *Pulmonaria Virginica*. Habitat, United States.
Willow Herb.	From *Epilobium angustifolium*. Nat. Ord. Onagraceæ. Used as a tonic and demulcent.

CHAPTER LI.

SUGARS AND SACCHARINE SUBSTANCES.

SUGARS may be defined as organic bodies having a sweet taste, generally of vegetable origin and crystallizable, of a neutral reaction, soluble in water, their solutions being optically active to polarized light. The term sugar is popularly applied to but one product, saccharose, the sweet substance obtained from sugar-cane, beets, sorghum, etc. There are, however, many sugars varying not only in external appearance and properties, but also in chemical composition. They may be divided into two classes: 1. Fermentable sugars, and, 2. Non-fermentable sugars.

1. **Fermentable Sugars.**—This is by far the more important class, as it embraces the sugars which are largely consumed in food-products. It will be found convenient to divide this class into two subclasses: *Glucoses*, or sugars *directly* subject to vinous fermentation, and *Saccharoses*, sugars *indirectly* subject to vinous fermentation. The following table shows these in detail:

Glucoses, $C_6H_{12}O_6$.

Glucose (Dextro-glucose, or Dextrose).	Rotates the plane of polarization strongly to the right. Obtained by treating starch with diluted sulphuric acid, neutralising the acid with lime, separating the calcium sulphate, and evaporating the solution.
Grape-Sugar (Crystallized Glucose).	Obtained by crystallising the above solution.
Lævulose (Lævo-glucose).	Rotates the plane of polarization strongly to the left. Found in the sugar-cane, and may be obtained from molasses, or by heating inulin under pressure with water.
Maltose, $C_{12}H_{22}O_{11} + H_2O$?	Made by the action of diastase on starch.
Dulcitose.	Obtained by oxidising dulcit with nitric acid.
Mannitose.	Found in muscular flesh.
Galactose.	Made by treating milk-sugar with diluted sulphuric acid.

Saccharoses, $C_{12}H_{22}O_{11}$.

Fermentable only after being converted into a sugar belonging to the class of glucoses.

Cane-Sugar (Saccharose).	Obtained from sugar-cane, beets, etc. (see Saccharum).
Parasaccharose.	Produced by spontaneous fermentation of cane-sugar
Milk-Sugar (Lactose, Lactin).	Obtained from milk (see Saccharum Lactis).
Mycose.	Obtained from ergot; identical with trehalose.
Melezitose.	Obtained from manna found in Tasmania and Persia.
Melitose.	Obtained from various species of Eucalyptus.
Trehalose.	Obtained from the cocoons of Larinus maculatus.

2. **Non-fermentable Sugars.**—These are sometimes termed *saccharoids*. Some of them have the chemical composition of glucose.

Mannit, $C_6H_{14}O_6$.	Obtained from Manna and many other plants.
Dulcit, $C_6H_{14}O_6$.	Also called Melampyrit. Obtained from Melampyrum nemorosum.
Eucalyn, $C_6H_{12}O_6$.	Produced in the fermentation of melitose.
Inosit, $C_6H_{12}O_6$.	Obtained from muscular flesh.
Quercitose, $C_6H_{12}O_5$.	By decomposing quercitrin with diluted sulphuric acid.
Sorbit, $C_6H_{12}O_6$.	From Sorbus aucuparia,—mountain-ash berries.
Erythromannit, $C_{12}H_{20}O_{12}$.	Obtained from Protococcus vulgaris, also called *Phycit*.
Isodulcit, $C_6H_{14}O_6$.	From quercitrin.
Pinit, $C_6H_{12}O_5$.	From Pinus Lambertiana.
Quercit, $C_6H_{12}O_5$.	Obtained from acorns.

Glucose, $C_6H_{12}O_6$, may be obtained from candied honey, from grapes, and from many other sources, but it is prepared from starch upon an immense scale by the action of very weak sulphuric acid. The term glucose is applied to the syrupy product of this process, while the name *grape-sugar* is applied to the solid product from the same source. The process is as follows. The corn is first soaked in warm water, and is then ground on specially-prepared stones with a stream of water. The meal is next passed into a trough, the bottom of which is made of fine bolting-cloth. Here the starch is washed through and led to large tanks, where it is allowed to settle. It is next beaten up with caustic soda to separate the gluten, and the starch is again allowed to settle in long shallow troughs. The starch, washed from all adhering alkali, is next beaten up with water into a cream, and conducted into the converting-tubs. Here the starch cream is treated with dilute sulphuric acid, and steam is allowed to bubble up through the mixture. This process of conversion, which is called "open conversion," is completed in about two hours. Another method is called "close conversion." The substances are enclosed in stout copper cylinders and subjected to the action of superheated steam. This process occupies about fifteen minutes. After conversion, the liquid is treated with marble-dust and animal charcoal. After neutralization, the liquid is filtered through cloth and animal charcoal, and is then conveyed to the vacuum-pan. When glucose syrup alone is desired, the process of conversion is stopped when the starch has disappeared, so that the syrup contains both glucose and dextrin, while, when solid grape-sugar is desired, the conversion is carried further to the change of dextrin into dextrose. Glucose can be obtained as a hydrate in small and laminated crystals from aqueous solution, and anhydrous in hard crystalline masses either from alcoholic solution or from very concentrated aqueous solution. It is less sweet than cane-sugar. It is also less soluble in water, and much more soluble in alcohol. It has the sp. gr. 1.54–1.57 when anhydrous. Strong mineral acids hardly act on grape-sugar, but destroy cane-sugar with facility. On the other hand, grape-sugar is destroyed by alkalies, with which cane-sugar forms definite compounds. Dissolved in water and subjected to prolonged ebullition, grape-sugar undergoes very little alteration. Its solution rotates the plane of polarization of polarized light to the right, and is capable of undergoing the vinous fermentation directly, without passing through any intermediate state. It is characterized, also, in boiling solution, by reducing alkaline tartrate of copper (see Test-Solution of Potassio-Cupric Tartrate), producing a reddish precipitate.

Manufactured glucose almost always contains calcium sulphate, which may be detected by adding a solution of barium nitrate, which produces a white precipitate of barium sulphate.

SACCHARUM. *U. S.* Sugar.

$C_{12}H_{22}O_{11}$; 342.

The refined sugar of *Saccharum officinarum* Linné (Nat. Ord. *Graminaceæ*).

Preparation.—Sugar is prepared commercially from the sugar-cane, beet-root, and sorghum. Formerly, sugar-cane was the only source; but at present the root of *Beta vulgaris* is largely used in Europe for making cane-sugar, and from the rapid growth of this industry there is a prospect of its supplanting all others. To prepare sugar the sugar-cane is crushed, and the juice, amounting to about 80 per cent., is expressed; this is then heated, a little lime and calcium bisulphite added, strained, and the liquid quickly evaporated, cooled, and stirred. The thick liquid is transferred to casks perforated at the bottom, and the crystals drained. Sugar made in this way is called "open pan" sugar. It is now almost completely displaced by "vacuum-pan" sugar.

In the production of raw sugars by the vacuum-pan process, the juice, after "defecation" with lime and removal of excess of lime by carbonic acid gas, is run through large filters of bone-black, and then into the vacuum-pan for concentration. The vacuum-pan is a large evaporating-pan, closed above by a dome-like top, which connects with an exhausting steam-pump, so that the liquid can be concentrated under very reduced pressure (see page 112). The heat is supplied by coils of steam-pipes which run through the interior of the pan. The saccharine juice is evaporated in this until it begins to crystallize, and even after this fresh portions are added, so that the crystals already formed grow by accretion of fresh material. After the crystallization is complete, the warm mixture of crystals and syrup is run into "centrifugals," to which a rapid revolution is given, and the crystals thus drained and dried.

Beet-root sugar is made in a similar manner, but is more troublesome to purify than that made from sugar-cane. The best sugar for pharmaceutical uses is known technically as "granulated."[1] Loaf-sugar is generally pure, but if kept in a damp atmosphere it is liable to absorb moisture, and if kept in a very dry air it will lose weight. For making troches, *lozenge-sugar*, a very pure, finely-powdered sugar, may be had through dealers in confectioners' supplies.

Saccharum. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
White, dry, hard, distinctly crystalline granules, permanent in the air. The aqueous solution, saturated at 15° C. (59° F.), has the sp. gr. 1.345, and is miscible with alcohol in all proportions.	Odorless; purely sweet taste; neutral reaction.	Cold. 0.5 part. Boiling. 0.2 part.	Cold. 175 parts. Boiling. 28 parts.	Soluble in 80 parts of boiling absolute alcohol, but insoluble in ether.

[1] The brand known as "Franklin Granulated" has proved satisfactory to the author.

Impurities.	Tests for Impurities.
Insoluble Salts, Foreign Matters, Ultramarine, Prussian Blue, etc.	Neither an aqueous nor an alcoholic solution of Sugar, kept in large, well-closed and completely filled bottles, should deposit a sediment on prolonged standing.
Grape-Sugar, and of more than a slight amount of Inverted Sugar.	If a portion of about 1 Gm. of Sugar be dissolved in 10 C.c. of boiling water, then mixed with 4 or 5 drops of test-solution of nitrate of silver and about 2 C.c. of water of ammonia, and quickly heated until the liquid begins to boil, not more than a slight coloration, but no black precipitate, should appear in the liquid after standing at rest for five minutes.

When sugar is crystallized in regular large monoclinic prisms, it is called *rock-candy*, and has the sp. gr. 1.606. The officinal test excludes sugar which contains ultramarine; this is often added by refiners to save the expense of using bone-black: a sugar not entirely free from yellow color can be blued by ultramarine, and the fault thus covered up, so that most consumers remain ignorant of the deception; when solution is attempted, however, it is discovered, for the syrup is never colorless, and a sediment is deposited. Sugar in dilute aqueous solution is converted into alcohol, carbon dioxide, and eventually acetic acid, if exposed to warm air.

Cane-sugar may be distinguished from grape-sugar by Trommer's test, which consists in the use of copper sulphate and caustic potassa. If a solution of cane-sugar be mixed with a solution of copper sulphate, and potassa be added in excess, a deep blue liquid is obtained, which on being heated deposits, after a time, a little red powder. A solution of grape-sugar, similarly treated, yields, by heat, a copious greenish precipitate, which rapidly changes to scarlet, and eventually to dark red. When heated to 185° C. (365° F.), cane-sugar melts into a viscid, colorless liquid, which on being suddenly cooled forms a transparent amorphous mass, called *barley-sugar*. At a higher temperature (between 204.4° C. and 215.5° C. (400° F. and 420° F.) it loses two molecules of water, and is converted into a very thick, black liquid, called *caramel*, which is used largely for coloring aqueous or hydro-alcoholic liquids. At a still higher heat it yields combustible gases, carbonic acid, empyreumatic oil, and acetic acid, and there remains one-fourth of its weight of charcoal, which burns without residue.

Uses.—Sugar is used principally in pharmacy for making syrups, troches, masses, confections, etc., as already noted.

Saccharures are preparations made by saturating sugar with tinctures, drying it, and then reducing the mixture to a fine powder.

Oleo-saccharures (Elæosacchara) are similar preparations made by incorporating one drop of a volatile oil with thirty grains of sugar: they form convenient modes of administering remedies to children.

MEL. *U.S.* Honey.

A saccharine secretion deposited in the honey-comb by *Apis mellifica* Linné (Class, *Insecta*; Order, *Hymenoptera*).

It is not known whether honey is secreted by the bee, or whether it exists ready formed in plants. The nectaries of flowers contain a

sweet substance, which is extracted by the insect. Large quantities of honey are obtained from California, the Southern States, and the West Indies. A still larger amount, however, is manufactured by flavoring and coloring artificial glucose. The officinal test ingeniously detects this adulteration through the nitrate of barium test, as already stated. Artificial glucose nearly always contains a trace of calcium sulphate, which produces a slight precipitate of barium sulphate (see page 673).

Mel. *U. S.*	Odor and Taste.	Solubility.
A syrupy liquid of a light yellowish or pale brownish-yellow color, translucent, gradually becoming crystalline and opaque. When diluted with 2 parts of water, the resulting liquid is almost clear, not stringy, has the sp. gr. 1.101 to 1.115, a brownish or yellowish color, and a faintly acid reaction.	Characteristic odor; sweet, faintly acrid taste.	Miscible with water and alcohol.

Impurities.	Tests for Impurities.
Chloride.	If 1 part of Honey be dissolved in 4 parts of water, a clear solution should result, which should not be rendered more than faintly opalescent by a few drops of test-solution of nitrate of silver.
Sulphate.	If 1 part of Honey be dissolved in 4 parts of water, a clear solution should result, which should not be rendered more than faintly opalescent by a few drops of test-solution of nitrate of barium.
Glucose or other Foreign Admixtures.	If a small portion of Honey be diluted with 1 volume of water and then gradually mixed with 5 volumes of absolute alcohol, it should not become more than faintly opalescent, and should neither become opaque, nor deposit a slimy substance at the bottom and along the sides of the test-tube. When incinerated in small portions at a time, in a platinum crucible, it should not leave more than 0.2 per cent. of ash.
Starch.	Water boiled with Honey, and allowed to cool, should not be rendered blue or green on the addition of test-solution of iodine.

Uses.—Honey is used pharmaceutically in the class Mellita (page 269), and as a vehicle and excipient. Owing to the difficulty of obtaining pure honey in large cities and towns, its place in many officinal preparations has been filled by substituting syrup or glycerin. Purified honey is officinal as Mel Despumatum (see page 269).

MANNA. *U. S.* Manna.

The concrete, saccharine exudation of *Fraxinus Ornus* Linné (Nat. Ord. *Oleaceæ*).

This substance, which is found in commerce of varying quality, is of a yellowish-white color externally; internally, white, porous, and crystalline. Its sp. gr. is 0.834. When pure, it is soluble in three parts of cold water and in its own weight of boiling water. It separates in crystalline masses from a boiling, saturated, aqueous solution. It is soluble in alcohol; boiling alcohol will dissolve fifteen per cent. of it, and upon cooling deposit beautiful crystals of mannit.

The principal constituent of manna is *mannit*, a peculiar, sweet principle, which is also found in many other plants.

Mannit is white, inodorous, crystallizable in semi-transparent needles, of a sweetish taste, soluble in five parts of cold water, scarcely soluble in cold alcohol, but readily dissolved by that liquid when hot, and de-

posited when it cools. Its composition is $C_6H_{14}O_6$, and it is considered as belonging to the class of *hexatomic alcohols*. It may be obtained by boiling manna in alcohol, allowing the solution to cool, and redissolving the crystalline precipitate: pure mannit is then deposited.

Uses.—Manna is used as a laxative, and often added to senna leaves to make a cathartic infusion. The dose is from one to two ounces.

GLYCYRRHIZA. *U.S.* Glycyrrhiza.

[LIQUORICE ROOT.]

The root of *Glycyrrhiza glabra* Linné (Nat. Ord. *Leguminosæ*, *Papilionaceæ*).

This well-known root contains the sweet principle *glycyrrhizin*, or *glycyrrhizic acid*, $C_{44}H_{63}NO_{18}$. This was found by Roussin to exist in the root in combination with ammonium. There is also present an oleoresinous substance which communicates to the root a slight acridity.

Uses.—Glycyrrhiza is valuable in pharmacy solely on account of the sweet principle. It is one of the most efficient substances known for masking the taste of bitter substances, like quinine sulphate, etc.

Officinal Preparations.

Extractum Glycyrrhizæ . . . . . Extract of Glycyrrhiza.	The commercial extract of the root, prepared by evaporating an aqueous extract and forming it into cylindrical rolls about six inches long (see page 382).
Extractum Glycyrrhizæ Purum . . Pure Extract of Glycyrrhiza.	Made by percolating glycyrrhiza with dilute solution of ammonia and evaporating the percolate to a pilular consistence (see page 383). (See Mistura, page 273.)
Pulvis Glycyrrhizæ Compositus . Compound Powder of Glycyrrhiza.	Made by mixing together 18 parts senna, 16 parts glycyrrhiza, 8 parts fennel, 8 parts washed sulphur, and 50 parts sugar, all in fine powder.
Extractum Glycyrrhizæ Fluidum . Fluid Extract of Glycyrrhiza.	Made of the strength of 1 C.c. representing 1 Gm., with a menstruum consisting of 3 parts of water of ammonia and 97 parts of diluted alcohol (see page 347).

GLYCYRRHIZINUM AMMONIATUM. *U.S.* Ammoniated Glycyrrhizin.

Glycyrrhiza, in No. 20 powder, 100 parts, or . . . . . **16 oz. av.**
Water,
Water of Ammonia,
Sulphuric Acid, each, a sufficient quantity.

Mix *ninety-five parts* [or 1 pint] of Water with *five parts* [or 6 fl. dr.] of Water of Ammonia, and, having moistened the powder with the mixture, macerate for twenty-four hours. Then pack it moderately in a cylindrical percolator and gradually pour water upon it until *five hundred parts* [or 5 pints] of percolate are obtained. Add to the percolate, slowly and while stirring, a sufficient quantity of Sulphuric Acid, so long as a precipitate is produced. Collect this on a strainer, wash it with cold Water, redissolve it in Water with the aid of Water of Ammonia, filter, if necessary, and again add Sulphuric Acid so long as a precipitate is produced. Collect this, wash it, dissolve it in a sufficient quantity of Water of Ammonia previously diluted with an equal volume of Water, and spread the clear solution upon plates of glass, so that, on drying, the product may be obtained in scales. The yield is about 10 per cent.

The introduction of this preparation is the result of the very important researches of Z. Roussin, who noticed that *glycyrrhizin*, the sweet principle of liquorice root, was insipid when compared with the root itself, and inferred that it existed in a modified form in the root. Experiment showed that alkalies developed the sweet taste, and he ultimately proved that the alkali with which it was combined in the root was ammonia, and that glycyrrhizin played the part of an acid. Liquorice root which has lost a portion of its sweetness through fermentation and the development of acetic acid and precipitation of insoluble glycyrrhizin can be restored to its former sweetness if allowed to remain a sufficient length of time in an ammoniacal atmosphere.

Uses.—This compound is useful when mixed with bitter or disagreeable powders to mask their taste.

TRITICUM. *U. S.* Triticum. [COUCH-GRASS.]

The rhizome of *Triticum repens* Linné (Nat. Ord. *Graminaceæ*), gathered in the spring and deprived of the rootlets.

Triticum is usually found in the market cut into small sections. It contains *triticin*, a principle resembling inulin, also glucose, lævulose, etc. It is used as a diuretic and for its special action on the urinary organs.

Officinal Preparation.

Extractum Tritici Fluidum . . Fluid Extract of Triticum.	**Made with boiling water, concentrated by evaporation, and preserved by the addition of a mixture of 1 part of alcohol and 4 parts of water (see page 363).**

CHAPTER LII.

DERIVATIVES OF SUGARS THROUGH THE ACTION OF FERMENTS.

Fermentation.—When certain organic bodies are subjected to the action of water, air, and a warm temperature, decomposition takes place. This is accompanied by the presence of microscopic organisms, and the result is the formation of new products. When decomposition is followed by the production of worthless or offensive substances, it is termed *putrefaction;* when useful products are formed, the process is called *fermentation.*

Two prominent theories accounting for the phenomena of fermentation have been advanced,—one, in which the action is regarded as a chemical process, the presence of the microscopic bodies being considered unimportant; the other, and by far the more generally accepted, that fermentation is caused by the presence of the organisms.

Ferments may be divided into two classes,—1. Organized or physiological ferments, as yeast, mycoderms, torulas, etc.; 2. Unorganized or chemical ferments, like diastase, synaptase, myrosin, etc. It will be necessary in the subsequent chapters to refer frequently to the various ferments and their products.

Vinous Fermentation.—Cane-sugar, as before stated, is capable of being decomposed by this process and converted into alcohol and carbon dioxide, but it will not undergo the vinous fermentation by itself. It requires to be dissolved in water, subjected to the influence of a ferment, and kept at a certain temperature. Accordingly, sugar, water, the presence of a ferment, and the maintenance of an adequate temperature must be deemed the prerequisites of the vinous fermentation. The water acts by giving fluidity, and the ferment and temperature by commencing and maintaining the chemical changes. The precise manner in which the ferment operates has not been positively determined; but the fermentative change seems to be intimately connected with the multiplication of a microscopic plant, *Torula cerevisiæ.*

Beginning with the simple substances cellulin and starch, it will be found that, through the action of dilute acids and ferments, they may be converted into alcohol or acetic acid:

$$\underset{\text{Cellulin or Starch.}}{(C_6H_{10}O_5)_3} + \underset{\text{Water.}}{H_2O} = \underset{\text{Maltose.}}{C_{12}H_{22}O_{11}} + \underset{\text{Starch.}}{C_6H_{10}O_5};$$

then

$$\underset{\text{Maltose.}}{C_{12}H_{22}O_{11}} + \underset{\text{Starch.}}{C_6H_{10}O_5} + \underset{\text{Water.}}{2H_2O} = \underset{\text{Glucose.}}{(C_6H_{12}O_6)_3};$$

then

$$\underset{\text{Glucose.}}{C_6H_{12}O_6} = \underset{\text{Alcohol.}}{(C_2H_5HO)_2} + \underset{\text{Carbon Dioxide.}}{2CO_2}.$$

And if the action is not arrested, the acetous fermentation begins, resulting in the conversion of the alcohol into acetic acid through oxidation:

$$\underset{\text{Alcohol.}}{C_2H_5HO} + \underset{\text{Oxygen.}}{O_2} = \underset{\text{Acetic Acid.}}{C_2H_4O_2} + \underset{\text{Water.}}{H_2O}.$$

The most important derivative of sugar through the action of a ferment is alcohol: this is usually obtained from whisky by distillation. The distilled product of vinous liquors forms the different ardent spirits of commerce. When obtained from wine, it is called *brandy;* from fermented molasses, *rum;* from cider, malted barley, or rye, *whisky;* from malted barley and rye-meal with hops, and rectified from juniper berries, *Holland gin;* from malted barley, rye, or potatoes, and rectified from turpentine, *common gin;* and from fermented rice, *arrack.* These spirits are of different strengths,—that is, contain different proportions of alcohol,—and have various peculiarities by which they are distinguished by the taste.

The compounds derived from sugars will be considered under the following subheads: 1. Ethyl hydrate and oxide and their preparations. 2. Preparations of the compound ethers of the ethyl and amyl series. 3. Aldehyd, its derivatives and preparations.

Ethyl Hydrate and Oxide and their Preparations.

The compounds containing the radical ethyl are the most important of those derived from organic substances, alcohol being the source of all.

Alcohol is regarded chemically as the type of a class of carbon compounds called alcohols, of which there are many important members. *They are the hydrates of the alcohol radicals* (ethyl hydrate, alcohol; amyl hydrate, amylic alcohol), just as slaked lime, or calcium hydrate, is the hydrate of the metal calcium.

Ethers are the *oxides of these radicals*, just as lime, or calcium oxide, is the oxide of the metal calcium.

Compound ethers are analogous to the salts of the metals, being formed by the decomposition of their alcohols by acids,—*i.e.*, ethyl nitrite, ethyl acetate, amyl nitrite,—just as potassium nitrate, sodium acetate, and calcium sulphate may be produced by decomposing the hydrates of their respective metals with acids. In each case water is formed as one of the results of the decomposition.

This may be shown by the reactions

$$\underset{\substack{\text{Sodium}\\\text{Hydrate.}}}{NaHO} + \underset{\substack{\text{Acetic}\\\text{Acid.}}}{C_2H_4O_2} = \underset{\substack{\text{Sodium}\\\text{Acetate.}}}{NaC_2H_3O_2} + \underset{\text{Water.}}{H_2O}.$$

$$\underset{\substack{\text{Alcohol or}\\\text{Ethyl Hydrate.}}}{C_2H_5HO} + \underset{\substack{\text{Acetic}\\\text{Acid.}}}{C_2H_4O_2} = \underset{\text{Ethyl Acetate.}}{C_2H_5C_2H_3O_2} + \underset{\text{Water.}}{H_2O}.$$

SPIRITUS FRUMENTI. *U. S.* Whisky.

An alcoholic liquid, obtained by the distillation of fermented grain (usually corn, wheat, or rye), and at least two years old.

Owing to the immense production of grain in this country, the cheapest sources of starch (corn, wheat, and rye) are used in making alcoholic liquids. The operations by which whisky is obtained from grain are technically termed,—1. *Mashing*, by which the starch is converted into sugar. 2. *Fermentation*, or the production of the alcohol. 3. *Distillation*, or the separation of the crude spirit.

The crushed grain, mixed with malt, is added to water at 15.4° C. (60° F.), and allowed to stand, to permit the conversion of the starch into maltose, through the action of the diastase. The liquid is now termed the *wort*. This is caused to ferment by the addition of yeast, and alcohol is gradually formed, carbon dioxide escaping: the liquor is then distilled, the distillate being termed *low wines*. This is again distilled, and *raw whisky* is the product. This upon keeping, especially in a warm room, improves in quality through the formation of compound ethers, which are supposed to communicate an agreeable flavor to the liquid.

Spiritus Frumenti. *U. S.*	Impurities.	Tests for Impurities.
Whisky has an amber color, a distinctive taste and odor, and a sp. gr. not above 0.930 nor below 0.917, corresponding approximately with an alcoholic strength of 44 to 50 per cent. by weight, or 50 to 58 per cent. by volume.	More than traces of Fusel Oil from grain or potato spirit.	If 100 C.c. of Whisky be very slowly evaporated in a weighed capsule, on a water-bath, the last portions volatilized should not have a harsh or disagreeable odor.
	An undue amount of Solids.	The residue, fully dried at 100° C. (212° F.), should weigh not more than 0.250 Gm., equivalent to 0.25 per cent.
	Added Sugar, Glycerin, or Spices.	This residue should have no sweet or distinctly spicy taste.
	Traces of Oak Tannin from casks.	The residue should nearly all dissolve in 10 C.c. of cold water, forming a solution which is colored light green by a dilute solution of ferric chloride.
	An undue amount of Free Acid.	100 C.c. of Whisky should be rendered distinctly alkaline to litmus by 2 C.c. of the volumetric solution of soda.

Uses.—Crude whisky is used as the source of alcohol. When purified and mellowed by age, it is used as a stimulant.

ALCOHOL. *U. S.* Alcohol.

A liquid composed of 91 per cent. by weight (94 per cent. by volume) of Ethyl Alcohol [C_2H_5HO; 46], and 9 per cent. by weight (6 per cent. by volume) of Water. Sp. gr. 0.820 at 15.6° C. (60° F.) and 0.812 at 25° C. (77° F.).

Preparation.—The natural sources of alcohol are starch and sugar as they exist in various plants, and alcohol, if pure, is the same from whatever source it is derived. It is generally made by distilling whisky, and redistilling and rectifying the distillate in an apparatus termed an alcohol column and still. The yield of alcohol, sp. gr. .835, obtained from good whisky is about 58 per cent. by volume. The principal

impurity is *fusel oil*, or amylic alcohol. Alcohol may be deprived of odor by treating it with potassium permanganate and redistilling. *Absolute alcohol* is the name given to the strongest alcohol which can be made, and which is intended to be absolutely free from water. This is a difficult preparation to make, owing to the very strong affinity existing between the two liquids. The strongest alcohol that can be made by simple distillation contains 11 per cent. of water, and in order to separate the latter from it, it is necessary to use some substance having a still stronger affinity for water. This is found in recently-burned lime, and the method employed is to percolate the strongest and purest alcohol attainable through the lime, out of contact with air, and then to redistil the percolate in vacuo. In this way alcohol may be obtained having a sp. gr. as low as 0.79355 at 15.6° C. (60° F.). (Squibb.) Absolute alcohol is a colorless, volatile liquid, of an agreeable odor and a burning taste. It boils at 78.4° C. (173.1° F.), and is not congealed by a cold of 166° below zero. Its freedom from water may be ascertained by dropping into it a piece of anhydrous baryta, which will remain unchanged if the alcohol be free from water, but otherwise will fall to powder; or (a more delicate test) by its forming a clear solution when mixed with an equal bulk of pure benzol. Absolute alcohol should be free from fusel oil.

Alcohol. *U. S.*	Impurities.	Tests for Impurities.
A transparent, colorless, mobile, and volatile liquid, of a characteristic, pungent, and agreeable odor, and a burning taste. It boils at 78° C. (172.4° F.), and is readily inflammable, giving a blue flame without smoke. Sp. gr. 0.820 at 15.6° C. (60° F.) and 0.812 at 25° C. (77° F.). It should not change the color of blue or red litmus paper previously moistened with water.	Fixed Impurities, or Coloring-Matter.	If a portion of at least 50 C.c. of Alcohol be evaporated to dryness in a glass vessel, no residue or color should appear.
	Fusel Oil.	If Alcohol is mixed with its own volume of water and one-fifth its volume of glycerin, a piece of blotting-paper, on being wet with the mixture, after the vapor of Alcohol has wholly disappeared, should give no irritating or foreign odor.
	Amyl Alcohol.	If a portion of Alcohol be evaporated to one-fifth its volume, the residue should not turn reddish upon the addition of an equal volume of sulphuric acid.
	Methyl Alcohol, Aldehyd, and Oak Tannin.	When Alcohol is treated, in a test-tube, with an equal volume of solution of potassa, there should not be an immediate darkening of the liquid.
	Methyl Alcohol.	If a portion of about 150 C.c. of Alcohol be digested for an hour with 20 Gm. of carbonate of lead, and filtered, the filtrate then distilled from a water-bath, and the first 20 C.c. of the distillate treated with 1 C.c. of test-solution of permanganate of potassium, the color should not disappear within one or two minutes.
	More than traces of Organic Matters, Fusel Oil, etc.	If 20 C.c. of Alcohol are shaken in a glass-stoppered vial, previously well rinsed with the same Alcohol, with 2 C.c. of test-solution of nitrate of silver, the mixture should not be rendered more than faintly opalescent during one day's exposure to direct sunlight.

It burns with a pale flame without residue, the products being carbonic acid and water. Absolute alcohol consists of two atoms of car-

bon, 24, six of hydrogen, 6, and one of oxygen, 16, = 46. Its empirical formula is, therefore, C_2H_6O. It is, however, recognized as the hydrate of the radical ethyl (C_2H_5), so that its rational formula would be C_2H_5,HO.

Alcohol is officinal of two strengths, the stronger having the sp. gr. 0.820; the other, diluted alcohol, having the sp. gr. 0.928.

Uses.—Alcohol is used in pharmacy principally for its solvent powers (see pages 300, 301). It is used as the source of many important compounds, like ether, chloroform, iodoform, etc., and as an antiseptic. It is of the utmost importance that alcohol should be of the best quality, as it is impossible to make creditable preparations with unclean spirit. Cologne spirit is generally a purified product, and cleaner than ordinary alcohol. A specially fine brand of alcohol can now be had which is rectified particularly for perfumers' use: it is said to be made by diluting the cologne spirit with sufficient water to bring it to about the strength of diluted alcohol, passing this through bone-black, and then redistilling and concentrating it again to the proper strength in the rectifying column and still. Preparations like elixir of orange and spirit of lemon depend greatly for their usefulness upon the freedom of the spirit from fusel oil and foreign odors.

ALCOHOL DILUTUM. *U.S.* Diluted Alcohol.

A liquid composed of 45.5 per cent. by weight (53 per cent. by volume) of Ethyl Alcohol and 54.5 per cent. by weight (47 per cent. by volume) of Water. Sp. gr. 0.928 at 15.6° C. (60° F.) and 0.920 at 25° C. (77° F.).

	By measure.
Alcohol, 50 parts, or	17 fl. oz.
Distilled Water, 50 parts, or	14 fl. oz.
To make 100 parts, or . . . about	30½ fl. oz.

Diluted Alcohol of this strength may be prepared from Alcohol of any higher percentage by the following rule, in which all terms denote weight. Divide the alcoholic percentage of the alcohol to be diluted by 45.5, and subtract 1 from the quotient. This gives the number of parts of water to be added to *one part* of the alcohol. Diluted Alcohol should respond to the tests of purity given under Alcohol.

When alcohol and water are mixed together, a contraction in volume takes place. In small operations this is generally disregarded; in larger operations the loss is very apparent. If 55 gallons of alcohol be mixed with 45 gallons of water, the product will not be 100 gallons of diluted alcohol, but only 96¼ gallons, showing a loss of 3¾ gallons. United States *Proof Spirit* differs from diluted alcohol in containing 50 per cent. *by volume* of absolute alcohol. It has the sp. gr. 0.934.

Uses.—Diluted alcohol is used as a menstruum in making tinctures, fluid extracts, extracts, etc. Its properties have been already fully described in connection with the various preparations. Its value consists not only in its antiseptic properties, but also in its possessing the solvent powers of both water and alcohol.

ALCOHOLMETRICAL TABLE.

Based on the Relation between Absolute Alcohol (Sp. Gr. 0.7938) and Pure Water at 15.6° C. (60° F.).—Abridged from Dr. E. R. Squibb's Table.

Percentage.		Specific Gravity.	Weight of One Pint.		Weight of One Gallon, Avoirdupois.		
By wt.	By vol.		In Gms	In Grs.	Lbs.	Oz.	Grs.
		1.0000	472.39	7290	8	5	132
	1	0.9985	471.68	7279	8	5	44
1		0.9981	471.49	7276	8	5	22
	2	0.9970	470.98	7268	8	4	395
2		0.9965	470.74	7264	8	4	366
	3	0.9956	470.31	7258	8	4	313
3		0.9947	469.89	7251	8	4	261
	4	0.9942	469.66	7248	8	4	232
4	5	0.9930	469.09	7239	8	4	162
5	6	0.9914	468.33	7227	8	4	68
6	7	0.9898	467.58	7216	8	3	413
	8	0.9890	467.19	7210	8	3	366
7		0.9884	466.91	7205	8	3	331
	9	0.9878	466.63	7201	8	3	296
8	10	0.9869	466.21	7194	8	3	243
9	11	0.9855	465.54	7184	8	3	161
10	12	0.9841	464.89	7174	8	3	81
11	13	0.9828	464.27	7165	8	3	5
	14	0.9821	463.94	7159	8	2	401
12	15	0.9815	463.65	7155	8	2	366
13	16	0.9802	463.04	7146	8	2	290
		0.9794	462.67	7140	8	2	244
14	17	0.9789	462.42	7136	8	2	214
		0.9784	462.19	7132	8	2	185
15	18	0.9778	461.90	7128	8	2	150
		0.9775	461.77	7126	8	2	123
		0.9772	461.62	7124	8	2	115
16	19	0.9766	461.34	7119	8	2	80
	20	0.9760	461.05	7115	8	2	45
17	21	0.9753	460.72	7110	8	2	4
		0.9749	460.54	7107	8	1	418
		0.9743	460.25	7103	8	1	383
18	22	0.9741	460.16	7101	8	1	373
		0.9737	459.97	7098	8	1	348
		0.9732	459.73	7095	8	1	319
19	23	0.9728	459.55	7092	8	1	297
		0.9720	459.16	7086	8	1	249
20	24	0.9716	458.98	7083	8	1	227
		0.9714	458.88	7081	8	1	214
	25	0.9709	458.65	7078	8	1	186
21		0.9704	458.41	7074	8	1	157
	26	0.9698	458.13	7070	8	1	122
		0.9693	457.90	7066	8	1	92
22	27	0.9691	457.80	7065	8	1	81
		0.9683	457.42	7059	8	1	33
23	28	0.9678	457.18	7055	8	1	5
		0.9671	456.85	7050	8	0	401
24	29	0.9665	456.57	7046	8	0	366
		0.9658	456.24	7041	8	0	325
25	30	0.9652	455.95	7036	8	0	290
		0.9645	455.63	7031	8	0	250
	31	0.9643	455.53	7030	8	0	238
26		0.9638	455.30	7026	8	0	209
	32	0.9631	454.96	7021	8	0	168
27		0.9623	454.58	7015	8	0	121
	33	0.9618	454.35	7011	8	0	92
28	34	0.9609	453.93	7005	8	0	40
		0.9602	453.59	7000	7	15	436
		0.9595	453.26	6995	7	15	395
29	35	0.9593	453.17	6993	7	15	383
		0.9587	452.88	6989	7	15	348
30	36	0.9578	452.46	6982	7	15	296
		0.9572	452.18	6978	7	15	261
	37	0.9565	451.84	6973	7	15	220
31		0.9560	451.61	6969	7	15	191
		0.9555	451.38	6966	7	15	162
	38	0.9550	451.14	6962	7	15	133
32		0.9544	450.86	6958	7	15	98
		0.9539	450.61	6954	7	15	68
	39	0.9535	450.43	6951	7	15	45
33		0.9528	450.09	6946	7	15	4
	40	0.9519	449.67	6939	7	14	390
34		0.9511	449.29	6933	7	14	343
	41	0.9503	448.91	6928	7	14	296
		0.9495	448.54	6922	7	14	250
35	42	0.9490	448.30	6918	7	14	221
		0.9475	447.59	6907	7	14	133
36	43	0.9470	447.36	6904	7	14	104
		0.9465	447.12	6900	7	14	75
37	44	0.9452	446.51	6890	7	13	437
		0.9446	446.22	6886	7	13	401
38	45	0.9434	445.66	6877	7	13	331
		0.9426	445.28	6871	7	13	284
39	46	0.9416	444.81	6864	7	13	226
		0.9405	444.29	6856	7	13	162
40	47	0.9396	443.86	6850	7	13	109
		0.9391	443.62	6846	7	13	75
	48	0.9381	443.15	6839	7	13	22
41		0.9376	442.92	6835	7	12	431
		0.9373	442.77	6833	7	12	413
	49	0.9362	442.25	6825	7	12	349
42		0.9356	441.97	6820	7	12	314
		0.9352	441.78	6818	7	12	291
	50	0.9343	441.35	6811	7	12	238
43		0.9335	440.98	6805	7	12	192
		0.9329	440.70	6801	7	12	157
	51	0.9323	440.42	6796	7	12	122
		0.9318	440.18	6793	7	12	93
44		0.9314	439.99	6790	7	12	69
		0.9306	439.61	6784	7	12	23
	52	0.9303	439.47	6782	7	12	5
45		0.9292	438.95	6774	7	11	379

ALCOHOLMETRICAL TABLE.—(Continued.)

Percentage.		Specific Gravity.	Weight of One Pint.		Weight of One Gallon, Avoirdupois.			Percentage.		Specific Gravity.	Weight of One Pint.		Weight of One Gallon, Avoirdupois.		
By wt.	By vol.		In Gms.	In Grs.	Lbs.	Oz.	Grs.	By wt.	By vol.		In Gms.	In Grs.	Lbs.	Oz.	Grs.
	53	0.9283	438.52	6767	7	11	326		79	0.8664	409.28	6316	7	3	216
46		0.9270	437.91	6758	7	11	251	78		0.8649	408.57	6305	7	3	129
	54	0.9262	437.53	6752	7	11	204		80	0.8639	408.10	6298	7	3	71
47		0.9249	436.92	6742	7	11	128	74		0.8625	407.44	6288	7	2	426
	55	0.9242	436.58	6737	7	11	87		81	0.8611	406.78	6277	7	2	344
		0.9236	436.30	6733	7	11	51	75		0.8603	406.40	6272	7	2	298
48		0.9228	435.93	6727	7	11	6			0.8599	406.21	6269	7	2	274
	56	0.9221	435.60	6722	7	10	402	76	82	0.8581	405.36	6255	7	2	169
		0.9212	435.17	6715	7	10	349			0.8566	404.65	6245	7	2	82
49		0.9206	434.88	6711	7	10	314	77	83	0.8557	404.22	6238	7	2	29
	57	0.9200	434.60	6707	7	10	279			0.8539	403.38	6225	7	1	361
50		0.9184	433.85	6695	7	10	186	78		0.8533	403.09	6220	7	1	327
	58	0.9178	433.56	6691	7	10	151		84	0.8526	402.77	6215	7	1	287
51	59	0.9160	432.71	6678	7	10	46			0.8516	402.29	6208	7	1	227
		0.9150	432.24	6670	7	9	425	79		0.8508	401.92	6202	7	1	182
52	60	0.9135	431.53	6659	7	9	338		85	0.8496	401.35	6194	7	1	112
		0.9124	431.01	6651	7	9	273	80		0.8483	400.73	6184	7	1	36
53	61	0.9113	430.49	6643	7	9	210		86	0.8466	399.93	6172	7	0	374
		0.9100	429.88	6634	7	9	133	81		0.8459	399.60	6167	7	0	333
54	62	0.9090	429.41	6627	7	9	76	82	87	0.8434	398.42	6148	7	0	187
		0.9075	428.69	6616	7	8	425			0.8415	397.52	6134	7	0	76
55	63	0.9069	428.41	6611	7	8	390	83	88	0.8408	397.19	6129	7	0	35
		0.9062	428.09	6606	7	8	350			0.8396	396.62	6121	6	15	402
56	64	0.9047	427.37	6595	7	8	262	84		0.8382	395.96	6110	6	15	322
		0.9036	426.86	6587	7	8	198		89	0.8373	395.53	6104	6	15	269
57	65	0.9025	426.34	6579	7	8	134	85		0.8357	394.78	6092	6	15	176
58	66	0.9001	425.20	6562	7	7	482		90	0.8340	393.98	6080	6	15	77
59		0.8979	424.17	6546	7	7	304			0.8336	393.79	6077	6	15	53
	67	0.8973	423.88	6541	7	7	269	86		0.8331	393.55	6073	6	15	24
		0.8966	423.55	6536	7	7	227			0.8317	392.89	6063	6	14	380
60		0.8956	423.07	6529	7	7	169	87	91	0.8305	392.33	6054	6	14	310
	68	0.8949	422.75	6524	7	7	129			0.8298	391.99	6049	6	14	269
61		0.8932	421.94	6511	7	7	29	88		0.8279	391.09	6035	6	14	158
	69	0.8925	421.62	6506	7	6	426		92	0.8272	390.76	6030	6	14	117
		0.8910	420.90	6495	7	6	338			0.8259	390.14	6021	6	14	41
62		0.8908	420.81	6494	7	6	326	89		0.8254	389.91	6017	6	14	12
	70	0.8900	420.43	6488	7	6	280		93	0.8237	389.11	6005	6	13	351
		0.8897	420.29	6486	7	6	262	90		0.8228	388.69	5998	6	13	299
63		0.8886	419.77	6478	7	6	198	91	94	0.8199	387.32	5977	6	13	130
	71	0.8875	419.25	6470	7	6	134	92		0.8172	386.04	5957	6	12	409
64		0.8863	418.68	6461	7	6	64		95	0.8164	385.66	5951	6	12	362
	72	0.8850	418.07	6452	7	5	426	93		0.8145	384.77	5938	6	12	252
65		0.8840	417.60	6444	7	5	368		96	0.8125	383.82	5923	6	12	135
	73	0.8825	416.88	6433	7	5	279	94		0.8118	383.49	5918	6	12	94
66		0.8816	416.46	6427	7	5	228	95		0.8089	382.12	5897	6	11	363
	74	0.8799	415.66	6414	7	5	129		97	0.8084	381.88	5893	6	11	334
67		0.8793	415.38	6410	7	5	94	96		0.8061	380.79	5876	6	11	200
68	75	0.8769	414.25	6393	7	4	391		98	0.8041	379.85	5862	6	11	83
69	76	0.8745	413.11	6375	7	4	251	97		0.8031	379.38	5855	6	11	25
		0.8739	412.83	6371	7	4	216	98		0.8001	377.96	5833	6	10	287
70	77	0.8721	411.98	6358	7	4	111		99	0.7995	377.68	5828	6	10	252
71	78	0.8696	410.79	6339	7	3	403	99		0.7969	376.45	5809	6	10	100
		0.8678	409.94	6326	7	3	297			0.7946	375.37	5793	6	9	404
72		0.8672	409.66	6322	7	3	263	100	100	0.7938	374.98	5787	6	9	357

* Officinal diluted alcohol.

† Officinal alcohol.

ÆTHER. *U.S.* Ether.

A liquid composed of about 74 per cent. of Ethyl Oxide [$(C_2H_5)_2O$; 74] and about 26 per cent. of Alcohol containing a little water. Sp. gr. about 0.750 at 15° C. (59° F.).

Preparation.—The Pharmacopœia of 1870 contained a process for the preparation of Ether. It was rarely or never used, because this is one of the liquids which cannot be safely or profitably made upon the small scale with the usual facilities afforded by the pharmacist's laboratory. Ether is made by acting on alcohol with sulphuric acid between the temperatures of 130° C. (266° F.) and 137.7° C. (280° F.). The sulphuric acid is not consumed in the process, but is regenerated, so that the making of ether is continuous. This will be understood when the reactions are explained. Ether is the oxide of the monad radical ethyl C_2H_5. Alcohol, as has been already stated, is the hydrate C_2H_5HO: now,

$$\underset{\text{Alcohol.}}{C_2H_5HO} + \underset{\substack{\text{Sulphuric}\\\text{Acid.}}}{H_2SO_4} = \underset{\substack{\text{Ethyl-sulphuric}\\\text{Acid.}}}{C_2H_5HSO_4} + \underset{\text{Water.}}{H_2O};$$

then

$$\underset{\substack{\text{Ethyl-sulphuric}\\\text{Acid.}}}{C_2H_5HSO_4} + \underset{\text{Alcohol.}}{C_2H_5HO} = \underset{\text{Ether.}}{(C_2H_5)_2O} + \underset{\substack{\text{Sulphuric}\\\text{Acid.}}}{H_2SO_4}.$$

Formerly it was believed that the sulphuric acid acted by catalysis, and that it dehydrated the alcohol through its affinity for water; but, the presence of ethyl-sulphuric acid, which was formed during the process, having been proved, this simple theory had to be abandoned.

The properties of Ether are given under Stronger Ether (see Æther Fortior). It dissolves in about five times its volume of water. Tested, as directed under Stronger Ether, the reaction should be neutral; on evaporation it should leave no fixed residue, and the last portion should have not more than a very slight foreign odor; a volume of 10 C.c., upon agitation with an equal volume of glycerin, should not be reduced to less than 7.5 C.c.

Uses.—This kind of ether is used as a solvent. It dissolves iodine and bromine freely, and sulphur and phosphorus sparingly. Its power to dissolve corrosive sublimate makes it a useful agent in the manipulations for detecting that poison. It is also a solvent of volatile and fixed oils, many resins and balsams, tannic acid, caoutchouc, and most of the alkaloids. It is not suited for inhalation, stronger ether being preferred (see below).

Ether should be kept in well-stopped bottles, or in soldered tins, in a cool place remote from lights and fire. Especial care should be observed in pouring ether from one vessel to another by gas-light: the vapor is heavy,—two and a half times as heavy as air,—and it will at once take fire with explosive force on contact with flame.

ÆTHER FORTIOR. *U.S.* Stronger Ether.

A liquid composed of about 94 per cent. of Ethyl Oxide [$(C_2H_5)_2O$; 74] and about 6 per cent. of Alcohol containing a little water. Sp. gr. not higher than 0.725 at 15° C. (59° F.) or 0.716 at 25° C. (77° F.).

Preparation.—Stronger ether is made in exactly the same way as ordinary ether (see above), and it differs from the latter merely in its greater strength and purity.

Æther Fortior. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A thin and very diffusive, clear, and colorless liquid. It boils at 37° C. (98.6° F.). Stronger Ether is highly inflammable, and its vapor, when mixed with air and ignited, explodes violently.	Refreshing, characteristic odor; burning and sweetish taste, slightly bitter after-taste; neutral reaction.	Eight times its volume of water.	All proportions.	All proportions of chloroform, benzol, benzin, fixed and volatile oils.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
It should boil actively, in a test-tube half filled with it and held a short time in the hand, on the addition of small pieces of broken glass. When 10 C.c. of Stronger Ether are agitated with an equal volume of glycerin in a graduated test-tube, the Ether layer, when fully separated, should not measure less than 8.6 C.c.	Acidity.	If a piece of pale blue litmus paper moistened with water be immersed ten minutes in a portion of the Ether, the color should not change.
	Non-volatile Impurities and Foreign Odors.	On evaporating at least 50 C.c. of Stronger Ether in a glass vessel, no fixed residue should appear, and, on evaporating a portion dropped upon blotting-paper, no foreign odor should be developed.

Uses.—Stronger ether is used pharmaceutically in preparing the oleoresins, but its chief use is as an anæsthetic. Too much care cannot be observed to see that the officinal tests are strictly complied with.

SPIRITUS ÆTHERIS. *U. S.* Spirit of Ether.

	By measure.
Stronger Ether, 30 parts, or	4 fl. oz.
Alcohol, 70 parts, or	8½ fl. oz.
To make 100 parts, or	12½ fl. oz.

Mix them.

Uses.—This simple mixture of ether and alcohol is used as a diffusible stimulant in doses of one to three fluidrachms.

SPIRITUS ÆTHERIS COMPOSITUS. *U. S.* Compound Spirit of Ether.

[Hoffmann's Anodyne.]

	By measure.
Stronger Ether, 30 parts, or	8 fl. oz.
Alcohol, 67 parts, or	16 fl. oz.
Ethereal Oil, 3 parts, or	5 fl. dr.
To make 100 parts, or about	24 fl. oz.

Mix them.

Commercial Hoffmann's anodyne is usually bought by the pharmacist and substituted for this preparation. It differs from the officinal liquid in containing variable proportions of light and heavy oil of wine, ether, and alcohol: it is obtained as a supplementary product by the manufacturing chemist.

During the rectification of crude ether, the distillation is continued as long as the ether comes over of the proper specific gravity; after which the receiver is changed, and an additional distillate is obtained,

consisting of ether and alcohol impregnated with a little ethereal oil. It is this second distillate, variously modified by the addition of alcohol, ether, or water, so as to make it conform in taste, smell, opalescence, etc., to a standard preparation kept by the manufacturer, that is sold as Hoffmann's anodyne.

The expensiveness of the ethereal oil is alleged to be the cause of this substitution. The cheap commercial liquid may be known by adding it to water: it usually mixes without causing milkiness. The officinal compound spirit of ether produces a slight opalescence when forty drops are added to a pint of water, and the peculiar odor of ethereal oil is distinctly noticed; but castor oil is sometimes added by dishonest manufacturers to circumvent this test. This fraud may be detected by mixing equal parts of the suspected liquid and water, and collecting the oil which separates on a piece of filtering-paper and exposing it to heat: a permanent greasy stain indicates a fixed oil, an ethereal oil stain disappears on heating.

Uses.—Compound spirit of ether is used as an anodyne, in doses of thirty minims to two fluidrachms. It is sometimes given in combination with laudanum.

Preparations of the Compound Ethers of the Ethyl and Amyl Series.

OLEUM ÆTHEREUM. *U. S.* Ethereal Oil.

A volatile liquid, consisting of equal volumes of Heavy Oil of Wine and of Stronger Ether.

Alcohol, 24 parts, or	14 fl. oz.
Sulphuric Acid, 54 parts, or	27 oz. av.
Distilled Water, 1 part, or	½ fl. oz.
Stronger Ether, a sufficient quantity.	

Add the Acid slowly to the Alcohol, mix them thoroughly, and allow the mixture to stand for twelve hours; then pour the clear liquid into a tubulated retort of such capacity that the mixture shall nearly fill it. Insert a thermometer through the tubulure, so that the bulb shall be deeply immersed in the liquid, and, having connected the retort with a well-cooled condenser, distil, by means of a sand-bath, at a temperature between 150° and 157° C. (302° and 314.6° F.), until the liquid ceases to come over, or until a black froth begins to rise in the retort. Separate the yellow, ethereal liquid from the distillate, and expose it to the air, for twenty-four hours, in a shallow capsule. Then transfer it to a wet filter, and, when the watery portion has drained off, wash the oil which is left on the filter with the Distilled Water. When this, also, has drained off, transfer the oil to a graduated measure, and add to it an equal volume of Stronger Ether.

Compound ethers, as already explained, are produced by the action of acids on alcohols (page 680). Ethereal oil is a mixture of compound ethers.

If alcohol is distilled with a large excess of sulphuric acid, there are formed towards the close of the distillation heavy oil of wine, sulphurous acid, olefiant gas, and empyreumatic products. The product of the dis-

tillation is generally in two layers, one consisting of water holding sulphurous acid in solution, and the other, of ether containing the heavy oil of wine. After separation, the latter liquid is exposed for twenty-four hours to the air, in order to dissipate the ether by evaporation; and the oil which is left is washed with water to deprive it of all traces of sulphurous acid.

In the early stage of the distillation of a mixture of sulphuric acid and alcohol, ethyl-sulphuric acid, $C_2H_5HSO_4$, is formed. During its progress this is decomposed so as to yield ether. When, however, the alcohol is distilled with a large excess of sulphuric acid, the ethyl-sulphuric acid is decomposed so as to form a small quantity of the *heavy oil of wine*. This is a mixture of ethyl sulphate, $(C_2H_5)_2SO_4$, ethyl sulphite, $(C_2H_5)_2SO_3$ (the sulphurous acid having been formed by reduction of sulphuric acid), with polymeric forms of ethylene, C_2H_4. Ethereal oil is a transparent, nearly colorless, volatile liquid, of a peculiar, aromatic, ethereal odor, a pungent, refreshing, bitterish taste, and a neutral reaction to dry litmus paper. Sp. gr. 0.910.

Uses.—Ethereal oil is used solely as an ingredient in compound spirit of ether.

SPIRITUS ÆTHERIS NITROSI. *U.S.* Spirit of Nitrous Ether.

[SWEET SPIRIT OF NITRE.]

An alcoholic solution of Ethyl Nitrite [$C_6H_5.NO_2$; 75], containing 5 per cent. of the crude Ether.

Nitric Acid, 9 parts, or . . . . . 4½ oz. av.
Sulphuric Acid, 7 parts, or . . . . . 3½ oz. av.
Alcohol,
Distilled Water, each, a sufficient quantity.

Add the Sulphuric Acid gradually to *thirty-one parts* [or 18 fl. oz.] of Alcohol. When the mixture has cooled, transfer it to a tubulated retort connected with a well-cooled condenser, to which a receiver, surrounded by broken ice, is connected air-tight, and which is further connected, by means of a glass tube, with a small vial containing water, the end of the tube dipping into the latter. Now add the Nitric Acid to the contents of the retort, and, having introduced a thermometer through the tubulure, heat rapidly, by means of a water-bath, until strong reaction occurs and the temperature reaches 80° C. (176° F.). Continue the distillation at that temperature, and not exceeding 82° C. (180° F.), until the reaction ceases. Disconnect the receiver, and immediately pour the distillate into a flask containing *sixteen parts* [or 8 fl. oz.] of ice-cold Distilled Water. Close the flask, and agitate the contents repeatedly, keeping down the temperature by immersing the flask occasionally in ice-water. Then separate the ethereal layer and mix it immediately with *nineteen times* its weight of alcohol. Keep the product in small, glass-stoppered vials, in a dark place, remote from lights or fire.

The object of this process is to form ethyl nitrite, a compound ether produced by substituting the acid radical for the hydrogen of the hydroxyl in the alcohol: this is then preserved from decomposition by the addition of sufficient alcohol.

The reactions for the production of ethyl nitrite from alcohol are as follows:

$$\underset{\text{Alcohol.}}{C_2H_6O} + \underset{\text{Nitric Acid.}}{HNO_3} = \underset{\text{Aldehyd.}}{C_2H_4O} + \underset{\text{Nitrous Acid.}}{HNO_2} + \underset{\text{Water.}}{H_2O};$$

then

$$\underset{\text{Alcohol.}}{C_2H_5(HO)} + \underset{\text{Nitrous Acid.}}{HNO_2} = \underset{\text{Ethyl Nitrite.}}{C_2H_5NO_2} + \underset{\text{Water.}}{H_2O},$$

Nitric acid reacts with alcohol to produce nitrous acid, aldehyd, and water; the nitrous acid then reacts with a second molecule of alcohol to form ethyl nitrite.

Pure ethyl nitrite is pale yellow, has the smell of apples, boils at 18° C. (64.4° F.), and has the sp. gr. 0.900 at 15.5° C. (60° F.). The density of its vapor is 2.627. Litmus is not affected by it. It is soluble in forty-eight parts of water, and in all proportions in alcohol or rectified spirit. It is highly inflammable, and burns with a white flame without residue. Mixed with an alcoholic solution of potassa, it becomes dark brown, showing the presence of aldehyd. When kept, it becomes acid in a short time, as shown by litmus; and nitric oxide is given off, which often causes the bursting of the bottle. Its tendency to become acid is rendered greater by the action of the air, and depends on the absorption of oxygen by the aldehyd, which is converted into acetic acid. These facts show the necessity of preserving this ether in small, strong bottles, kept full and in a cool place, and, in warm weather, of cooling a bottle thoroughly before opening it.

Spiritus Ætheris Nitrosi. *U.S.*	Odor and Taste.	Solubility.
A clear, mobile, volatile and inflammable liquid, of a pale straw-color, inclining slightly to green. Sp. gr. 0.823 to 0.825. It slightly reddens litmus paper, but should not effervesce when a crystal of bicarbonate of potassium is dropped into it. When mixed with half its volume of solution of potassa, previously diluted with an equal volume of water, it assumes a yellow color, which slightly deepens, without becoming brown, in twelve hours.	Fragrant, ethereal odor, free from pungency; sharp, burning taste.	Miscible with water and alcohol in all proportions.

Test for Identity.	Quantitative Test.
A portion of the Spirit, in a test-tube half filled with it, plunged into water heated to 63° C. (145.4° F.), and held there until it has acquired that temperature, should boil distinctly on the addition of a few small pieces of glass.	If 10 Gm. of Spirit of Nitrous Ether be macerated with 1.5 Gm. of potassa for twelve hours, with occasional agitation, the mixture then diluted in a beaker with an equal volume of water, and set aside until the odor of alcohol has disappeared, then slightly acidulated with diluted sulphuric acid, and a solution of 0.335 Gm. of permanganate of potassium gradually added, the color of the whole of this solution should be discharged (presence of at least 4 per cent. of real Ethyl Nitrite).

Spirit of nitrous ether is never quite free from aldehyd; and, if the distillation is too long continued, it is apt to contain a good deal of this liquid, which afterwards becomes acetic acid by absorbing oxygen. The change goes on rapidly if the preparation be insecurely kept. Aldehyd, if in considerable proportion, may be detected by imparting a pungent

odor and acrid flavor, and by the preparation assuming a brown tint on the addition of a weak solution of potassa, owing to the formation of aldehyd resin. The officinal potassa test, with the best specimens, produces a straw-yellow tint within twelve hours.

Specific gravity cannot be relied upon as a test of the quantity of ethyl nitrite present, because both it and water are heavier specifically than the diluting liquid, alcohol. The sp. gr. of alcohol being 0.820, and that of spirit of nitrous ether 0.823 to 0.825, it follows that the heavier specific gravity of the latter should be caused by the addition of ethyl nitrite (sp. gr. 0.900), but it may be increased by diluting it with water (sp. gr. 1.000), or by adding alcohol of the sp. gr. 0.825, and this is a common practice. It unfortunately happens that no simple, practical test has yet been discovered to determine the percentage of ethyl nitrite in the spirit, and the officinal quantitative test is very unreliable: so that the safest course for the pharmacist to pursue is to make his own spirit of nitrous ether, which may be easily done by following out the officinal process.

Uses.—Spirit of nitrous ether is a valuable diaphoretic and diuretic. The dose is thirty minims to one fluidrachm.

ÆTHER ACETICUS. *U.S.* Acetic Ether.

$C_2H_5C_2H_3O_2$; 88. [ACETATE OF ETHYL.]

Preparation.—Acetic ether may be made in several ways. The best method is probably that of distilling a mixture of sixteen parts of dried sodium acetate, ten parts of alcohol, and twenty parts of sulphuric acid, shaking the distillate in a bottle with exsiccated sodium acetate, and subsequently redistilling it. It is a solution of ethyl acetate in a mixture of alcohol and water.

$$\underset{\text{Sodium Acetate.}}{NaC_2H_3O_2} + \underset{\text{Ethyl Sulphuric Acid.}}{C_2H_5HSO_4} = \underset{\text{Ethyl Acetate.}}{C_2H_5C_2H_3O_2} + \underset{\text{Acid Sodium Sulphate.}}{NaHSO_4}.$$

Ethyl sulphuric acid is formed through the action of the sulphuric acid and heat upon the alcohol. This is then decomposed by contact with sodium acetate, ethyl acetate and acid sodium sulphate being produced.

Æther Aceticus. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A transparent and colorless liquid. It boils at about 76° C. (168.8° F.). It is inflammable, burning with a bluish-yellow flame and acetous odor.	Strong, fragrant, ethereal and somewhat acetous odor; refreshing taste; neutral reaction.	17 parts.	All proportions.	In all proportions of ether and chloroform.

Impurities.	Tests for Impurities.
Free Acid, fixed residue.	Acetic Ether should not change the color of blue litmus paper previously moistened with water, nor leave any fixed residue upon evaporation.
Alcohol, Ether.	When 10 C.c. of Acetic Ether are agitated with an equal volume of water, in a graduated test-tube, the upper, ethereal layer, after its separation, should not measure less than 9 C.c.

Uses.—Acetic ether is sometimes employed as an anæsthetic. It is used officinally as one of the ingredients in tincture of acetate of iron. Its odor is frequently noticed in old tinctures and extemporaneous mixtures which have once contained alcohol and acetic acid.

AMYL NITRIS. *U. S.* Nitrite of Amyl.

$C_5H_{11}NO_2$; 117.

Preparation.—This compound ether may be made by acting on amylic alcohol with nitric acid. The latter is deoxidized into nitrous acid, which acts on amylic alcohol, as shown in the reaction:

$$\underset{\text{Amylic Alcohol.}}{C_5H_{11}HO} + \underset{\text{Nitrous Acid.}}{HNO_2} = \underset{\text{Amyl Nitrite.}}{C_5H_{11}NO_2} + \underset{\text{Water.}}{H_2O}.$$

Amyl Nitris. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A clear, pale yellowish liquid. When freely exposed to air it decomposes, leaving a large residue of amyl alcohol. It boils at about 96° C. (205° F.), giving an orange-colored vapor. It burns with a fawn-colored flame. Sp. gr. 0.872 to 0.874.	Ethereal, fruity odor; aromatic taste; neutral or slightly acid reaction.	Insoluble.	In all proportions.	In all proportions of ether, chloroform, benzol, and benzin.

Tests for Identity.	Impurities.	Tests for Impurities.
Nitrite of amyl, warmed with excess of solution of potassa, gives the odor of amyl alcohol. If this alkaline mixture be treated with a little test-solution of iodide of potassium, and then with acetic acid to an acid reaction, there is an immediate separation of iodine, and on the addition of gelatinized starch a deep blue color appears (distinction from nitrate).	Free Acid.	On shaking 10 C.c. of Nitrite of Amyl with 2 C.c. of a mixture of 1 part of water of ammonia and 9 parts of water, the liquid should not redden blue litmus paper.
	Water.	It should remain transparent, or nearly so, when exposed to the temperature of melting ice.

Tanner's process, which is adapted for small operations, is as follows: 10 fl. oz. of purified amylic alcohol is introduced into a large tubulated retort containing copper wire, 1 fl. oz. of strong sulphuric acid is now added, and then 1 fl. oz. of nitric acid, previously diluted with an equal bulk of water. It is gently heated to 63° C. (145.4° F.). At this temperature the reaction commences, and goes on very quietly until a bulk about equal to double the quantity of nitric acid collects in the receiver. The chemical movement now ceases, and the temperature, which has risen to near 100° C. (212° F.), begins to fall. More dilute nitric acid is added, and the process carried out as before. These additions are repeated until the amylic alcohol is exhausted, which is known by the appearance of red fumes in the retort. The whole product is washed with caustic soda, to remove hydrocyanic and other acids, and rectified over carbonate of potassium, to get rid of moisture. The portion which distils over between 95° C. (203° F.) and 100° C. (212° F.) is medicinally pure nitrite of amyl.

Difficulties are experienced in rectifying nitrite of amyl on account of the number of products present having similar boiling-points. If strong nitric acid is used instead of diluted acid, explosions are almost sure to occur.

Uses.—Amyl nitrite is one of the valuable new remedies. It is very volatile, and is used in asthma, angina pectoris, and similar complaints, by inhalation. It is a stimulant, producing an excessive action of the heart, and may be administered by dropping a small quantity on a handkerchief and inhaling the vapor, or by crushing a glass *pearl of nitrite of amyl* in the handkerchief and inhaling.

CHAPTER LIII.

ALDEHYD, ITS DERIVATIVES AND PREPARATIONS.

THE term *aldehyd*, like the terms *alcohol* and *ether*, was formerly applied to one compound. It is now used to define a class of organic bodies. The word is derived from the first syllables of the term *al*cohol *dehyd*rogenatum, which means alcohol from which hydrogen has been abstracted.

Aldehyd has the composition C_2H_4O, and is made by depriving alcohol, C_2H_6O, of two hydrogen atoms. This abstraction of hydrogen may be effected by acting on alcohol with oxidizing agents, as in making ethyl nitrite, and in other ways. By the oxidation of aldehyds acids are formed, as in making acetic acid by the beech-wood shavings process (see page 654). The addition of 2H to aldehyd, C_2H_4O, reproduces alcohol, C_2H_6O, whilst the addition of O to aldehyd, C_2H_4O, produces acetic acid, $C_2H_4O_2$.

CHLORAL. *U. S.* Chloral.

C_2HCl_3O,H_2O; 165.2. [HYDRATE OF CHLORAL.]

Chloral should be preserved in glass-stoppered bottles, in a cool and dark place.

Preparation.—This valuable compound is made by passing dry chlorine gas, in a continuous stream, through absolute alcohol for six or eight weeks. The chlorine is led into cold alcohol at first, and when no more is absorbed, the alcohol is heated at first gently and then to 60° C. (140° F.). When saturated, the mixture formed is agitated with sulphuric acid at a temperature of 60° C. (140° F.) for several hours, during which time most of the hydrochloric acid escapes. The separated chloral is then rectified over calcium carbonate. This is anhydrous chloral, a colorless liquid, of a penetrating odor, of the sp. gr. 1.502. The pure chloral so obtained is then mixed in glass flasks with the necessary amount of water, and the resulting hydrate either cast into cakes or purified by crystallization. As solvents for this purpose, certain of the side-products of the chloral manufacture, after being purified and rectified, are used,—for instance, ethylen and ethyliden chloride; or, in their absence, chloroform, petroleum benzin, or bisulphide of carbon may be employed. The name *chloral* is derived from the first two syllables of *chlor*ine and *al*cohol.

The reaction may be thus expressed:

$$\underset{\text{Alcohol.}}{C_2H_4H_2O} + \underset{\text{Chlorine.}}{2Cl} = \underset{\text{Aldehyd.}}{C_2H_4O} + \underset{\text{Hydrochloric Acid.}}{2HCl};$$

then

$$\underset{\text{Aldehyd.}}{C_2H_4O} + \underset{\text{Chlorine.}}{6Cl} = \underset{\text{Chloral.}}{C_2HCl_3O} + \underset{\text{Hydrochloric Acid.}}{3HCl}.$$

Chloral is thus seen to be aldehyd in which three of the atoms of hydrogen have been replaced by three atoms of chlorine: hence it is termed, in systematic nomenclature, *trichloraldehyd.*

Chloral. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Separate, rhomboidal, colorless and transparent crystals, slowly evaporating when exposed to air. It liquefies when mixed with carbolic acid or with camphor. Its aqueous solution soon acquires an acid reaction, but its alcoholic solution remains neutral. At about 58° C. (136.4° F.) it melts to a clear liquid, which solidifies to a crystalline mass at a temperature between 35° and 50° C. (95° and 122° F.). At about 78° C. (172° F.) it begins to yield vapors of water and of anhydrous chloral, and it boils at 95° C. (203° F.).	Aromatic, penetrating, and slightly acrid odor; a bitterish, caustic taste; neutral reaction.	Freely soluble.	Freely soluble.	Freely soluble in ether, also soluble in 4 parts of chloroform, in glycerin, benzol, benzin, disulphide of carbon, fixed or volatile oils.

Tests for Identity.	Impurities.	Tests for Impurities.
When dissolved in water and treated, while hot, with solution of potassa or of soda, or with water of ammonia, a vaporous, milky mixture of chloroform is obtained, with a formate in solution. If the addition of the water of ammonia be made in a test-tube, after adding a few drops of test-solution of nitrate of silver, a silver mirror will be obtained upon the glass. An aqueous solution, treated with test-solution of sulphide of ammonium, gives a reddish-brown precipitate.	Acids.	When Chloral is dissolved in diluted alcohol it should not redden blue litmus paper.
	Hydrochloric Acid.	When Chloral is dissolved in diluted alcohol it should not be precipitated upon addition of a few drops of nitric acid, and of test-solution of nitrate of silver.
	Organic Impurities.	Warmed in contact with an equal volume of sulphuric acid, it liquefies, but should not blacken.
	Inorganic Impurities.	When vaporized by heat, no residue should remain.
Chloral should be dry, and should not readily attract moisture in ordinarily dry air. It should not dissolve in less than four times its weight of chloroform at 15° C. (59° F.), (difference from alcoholate). A portion, in a test-tube, containing a fragment of broken glass, held in water nearly boiling, should boil at about 97° C. (206.6° F.), (difference from alcoholate, which boils at 115° C. (239° F.), and evidence of due hydration).	Alcoholate of Chloral.	If 1 Gm. of Chloral be dissolved in 2 C.c. of distilled water, the solution warmed, and about 8 C.c. (or a slight excess) of solution of potassa added, the mixture filtered clear through wet filter paper, and the filtrate treated with test-solution of iodine until it is yellowish, no yellow, crystalline precipitate (iodoform) should appear, even after standing half an hour.

Uses.—Hydrate of chloral is a hypnotic: it is generally administered in a flavored syrup. The dose is fifteen to thirty grains.

CHLOROFORMUM VENALE. *U.S.* Commercial Chloroform.

A liquid containing at least 98 per cent. of Chloroform.

Preparation.—Chloroform is made by mixing six parts of chlorinated lime with twenty-five parts of water, and after transferring the mixture

to a still, one part of alcohol is added. Heat is applied, and when the temperature of 40° C. (122° F.) is reached, chloroform containing some alcohol begins to distil over. This is washed with water to separate the alcohol, and the heavy liquid is further purified by redistillation. (See Chloroformum Purificatum.)

Chloroform, $CHCl_3$, is termed chemically *trichlormethane*, because it can be produced by substituting three atoms of chlorine for three hydrogen atoms of *methane*, marsh-gas, CH_4. It may also be produced by acting on chloral hydrate with an alkali, and this process is sometimes used upon a commercial scale.

$$\underset{\text{Chloral Hydrate.}}{C_2HCl_3OH_2O} + \underset{\substack{\text{Potassium}\\\text{Hydrate.}}}{KHO} = \underset{\text{Chloroform.}}{CHCl_3} + \underset{\substack{\text{Potassium}\\\text{Formate.}}}{KCHO_2} + \underset{\text{Water.}}{H_2O}.$$

When made from alcohol and chlorinated lime, the reactions are more complicated. In the first place, aldehyd, calcium chloride, and water are formed, thus:

$$\underset{\text{Alcohol.}}{C_2H_6O} + \underset{\substack{\text{Calcium}\\\text{Hypochlorite.}}}{CaOCl_2} = \underset{\text{Aldehyd.}}{C_2H_4O} + \underset{\substack{\text{Calcium}\\\text{Chloride.}}}{CaCl_2} + \underset{\text{Water.}}{H_2O}.$$

Then the aldehyd reacting with calcium hypochlorite is decomposed, chloral, calcium chloride, and calcium hydrate being produced.

$$\underset{\text{Aldehyd.}}{(C_2H_4O)_2} + \underset{\substack{\text{Calcium}\\\text{Hypochlorite.}}}{6(CaOCl_2)} = \underset{\text{Chloral.}}{(C_2HCl_3O)_2} + \underset{\substack{\text{Calcium}\\\text{Chloride.}}}{3CaCl_2} + \underset{\substack{\text{Calcium}\\\text{Hydrate.}}}{3Ca(HO)_2}.$$

Then chloral is decomposed by calcium hydrate, chloroform and calcium formate being produced.

$$\underset{\text{Chloral.}}{(C_2HCl_3O)_2} + \underset{\substack{\text{Calcium}\\\text{Hydrate.}}}{Ca(HO)_2} = \underset{\text{Chloroform.}}{(CHCl_3)_2} + \underset{\text{Calcium Formate.}}{Ca(CHO_2)_2}.$$

The tests of the U. S. Pharmacopœia are as follows. Its sp. gr. should not be lower than 1.470. If 1 C.c. be agitated with 20 C.c. of distilled water, the latter, when separated, should not render test-solution of nitrate of silver more than slightly turbid (limit of foreign chlorine compounds). When shaken with an equal volume of sulphuric acid, the subsiding acid layer should not become quite black within twenty-four hours. A portion evaporated should leave no fixed residue.

Uses.—Commercial chloroform should be employed only in preparations for external application, or as a solvent. (See Chloroformum Purificatum.)

CHLOROFORMUM PURIFICATUM. *U.S.* **Purified Chloroform.**

$CHCl_3$; 119.2.

	By measure.
Commercial Chloroform, 200 parts, or	70 fl. oz.
Sulphuric Acid, 40 parts, or	11½ fl. oz.
Carbonate of Sodium, 10 parts, or	5 oz. av.
Lime, in coarse powder, 1 part, or	½ oz. av.
Alcohol, 2 parts, or	1¼ fl. oz.
Water, 20 parts, or	10 fl. oz.

Add the Acid to the Chloroform and shake them together, occasionally, during twenty-four hours. Separate the lighter liquid and add to

it the Carbonate of Sodium previously dissolved in the water. Agitate the mixture thoroughly for half an hour and set it aside; then separate the Chloroform from the supernatant layer, mix it with the Alcohol, transfer it to a dry retort, add the Lime, and, taking care that the temperature in the retort does not rise above 67.2° C. (153° F.), distil, by means of a water-bath, into a well-cooled receiver, until the residue in the retort is reduced to *two parts* [or 6 fl. dr.]. Keep the product in glass-stoppered bottles, in a cool and dark place.

Commercial chloroform contains a chlorinated pyrogenous oil which renders it unfit for its most important use, that of an anæsthetic, and the object of the above process is to purify it. Sulphuric acid decomposes this contaminating oil, and in turn is blackened by it. The chloroform is separated from the sulphuric acid, agitated with solution of sodium carbonate to neutralize adhering acid, then mixed with alcohol, which acts as a preservative from decomposition, and redistilled from lime to separate water.

Chloroformum Purificatum. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A heavy, clear, colorless, diffusive liquid. Sp. gr. 1.485–1.490. It boils at 60° to 61° C. (140° to 142° F.), corresponding to the presence of three-fourths (¾) to one (1) per cent. of alcohol.	Characteristic, pleasant, ethereal odor; burning, sweet taste; neutral reaction.	200 parts.	All proportions.	All proportions of ether, also benzol, benzin, fixed or volatile oils.

Impurities.	Tests for Impurities.
Acids.	If 5 C.c. of Purified Chloroform be thoroughly agitated with 10 C.c. of distilled water, the latter, when separated, should not affect blue litmus paper.
Chloride.	If 5 C.c. of Purified Chloroform be thoroughly agitated with 10 C.c. of distilled water, the latter, when separated, should not be affected by test-solution of nitrate of silver.
Free Chlorine.	If 5 C.c. of Purified Chloroform be thoroughly agitated with 10 C.c. of distilled water, the latter should not be affected by test-solution of iodide of potassium.
Aldehyd.	If a portion of Purified Chloroform be digested, warm, with solution of potassa, the latter should not become dark-colored.
Organic Impurities.	On shaking 10 C.c. of the Chloroform with 5 C.c. of sulphuric acid, in a glass-stoppered bottle, and allowing them to remain in contact for twenty-four hours, no color should be imparted to either liquid.
Volatile Impurities.	If a few C.c. be permitted to evaporate from blotting-paper, no foreign odor should be perceptible after the odor of Chloroform ceases to be recognized.

Uses.—Purified chloroform is used as an anæsthetic by inhalation. Taken internally, in large doses (one to two fluidrachms) it is narcotic; in small doses (ten to fifteen minims) it is carminative and sedative. Externally it is irritant, and may produce blisters.

Officinal Preparations.

Spiritus Chloroformi . . . Made by mixing 10 parts of purified chloroform with 90 parts of alcohol.
Spirit of Chloroform.

Mistura Chloroformi . . . Made by mixing 8 parts of purified chloroform with 2 parts of camphor, 10 parts of yolk of egg, and 80 parts of water (see page 272).
Chloroform Mixture.

Linimentum Chloroformi . Made by mixing 40 parts of commercial chloroform with 60 parts of soap liniment.
Chloroform Liniment.

IODOFORMUM. *U.S.* Iodoform.

CHI_3; 392.8.

Preparation.—Iodoform may be made by Filhol's process, which consists in heating, in a water-bath, one hundred parts of alcohol, two hundred parts of acid potassium carbonate, and one thousand parts of distilled water, and gradually adding one hundred parts of iodine in small portions. Chlorine gas is passed through the mixture to cause the separation of the iodoform, which may be filtered out. The filtrate may be concentrated and decomposed by excess of nitric acid. The collected crystals of iodoform are now well washed with the smallest quantity of cold distilled water, spread out on pieces of bibulous paper, and dried in the open air.

$$\underset{\text{Alcohol.}}{C_2H_5HO} + \underset{\text{Iodine.}}{8I} + \underset{\text{Acid Potassium Carbonate.}}{2KHCO_3} = \underset{\text{Potassium Iodide.}}{2KI} + \underset{\text{Iodoform.}}{2CHI_3} + \underset{\text{Water.}}{3H_2O} + \underset{\text{Carbon Dioxide.}}{2CO_2}$$

Iodoformum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Small, lemon-yellow, lustrous crystals of the hexagonal system. Sp. gr. 2.000.	Saffron-like and almost insuppressible odor; unpleasant, slightly sweetish, iodine-like taste; solutions have a neutral reaction.	Not perceptibly soluble in water, to which it imparts a slight odor and taste.	Cold. 80 parts. Boiling. 12 parts.	Soluble in 5.2 parts of ether, and in chloroform, benzol, benzin, disulphide of carbon, fixed and volatile oils.

Tests for Identity.	Impurities.	Tests for Impurities.
It sublimes slightly at ordinary temperatures, and distils slowly with water; at about 115° C. (239° F.) it melts to a brown liquid, and at a higher temperature yields vapors containing iodine and carbonaceous matter. If Iodoform be digested with an alcoholic solution of potassa, the mixture, when acidulated with diluted nitric acid, will give a blue color with gelatinized starch.	Iodine.	Distilled water shaken with Iodoform should not change the color of blue litmus paper, and when filtered should give no precipitate with test-solution of nitrate of silver.
	Foreign Impurities.	Upon full combustion, Iodoform should leave no residue.

Uses.—Iodoform is used principally as an alterative. It is also antiseptic and anæsthetic. The dose is one to three grains.

Officinal Preparation.

Unguentum Iodoformi . 10 parts of Iodoform to 90 parts of Benzoinated Lard. Iodoform Ointment.

Unofficinal Ethyl and Amyl Compounds, and Allied Products.

Aldehyd, C_2H_4O.	By gently warming a mixture of alcohol, black oxide of manganese, sulphuric acid, and water, and collecting the vapor which is formed by means of a condenser. If exposed, it will gradually be converted into acetic acid. It is a colorless, thin, and very inflammable liquid, having an ethereal odor, and the sp. gr. .805.
Amyl Acetate, $C_5H_{11}.C_2H_3O_2$.	By distilling amyl alcohol with an acetate and sulphuric acid. It is when pure a colorless liquid having a very fragrant odor. Insoluble in water. Sp. gr. .876.
Amyl Butyrate, $C_5H_{11},C_4H_7O_2$.	Sp. gr. .852. Fragrant odor.
Amyl Chloride, C_5H_{11},Cl.	By the action of strong hydrochloric acid upon amylic alcohol. Sp. gr. .874.

Unofficinal Ethyl and Amyl Compounds, and Allied Products.—(*Continued.*)

Amyl Iodide, $C_5H_{11}.I.$	By acting upon amylic alcohol with iodine and phosphorus. It is a colorless, transparent liquid, of a faint odor and a pungent taste. Sp. gr. 1.509.
Amyl Valerianate, $C_5H_{11},C_5H_9O_2.$	Sp. gr. .864. Odor of apples.
Barium Sulphethylate, $Ba(C_2H_5SO_4)_2.$	By neutralizing ethyl-sulphuric acid with barium carbonate, filtering off the insoluble barium sulphate, and evaporating the filtrate to crystallization.
Bromoform, $CHBr_3.$	By acting simultaneously upon wood spirit with bromine and potassa. It is a limpid liquid, resembling chloroform, and has an agreeable odor and a saccharine taste.
Butyl Chloral, $C_4H_9Cl_3O.$	By passing chlorine gas into aldehyd, when it is formed in addition to chloral. It is a dense, oily liquid, of peculiar odor. It dissolves when treated with an excess of warm water, and on cooling deposits *Butyl chloral-hydrate.*
Butyl Chloral-Hydrate.	
Calcium Sulphethylate, $Ca(C_2H_5SO_4)_2.$	By neutralizing ethyl-sulphuric acid with calcium carbonate, filtering off the insoluble calcium sulphate, and evaporating the filtrate to crystallization.
Copper Sulphethylate, $Cu(C_2H_5SO_4)_2.$	By mixing alcoholic solutions of ethyl sulphydrate and copper acetate and collecting the gelatinous precipitate.
Croton Chloral Hydrate.	The same as butyl chloral-hydrate (see above).
Ethyl Acetate, $C_2H_5,C_2H_3O_2.$	By distilling sodium or lead acetate with alcohol and sulphuric acid.
Ethyl Benzoate, $C_2H_5.C_7H_5O.$	By heating to 100° C. in a sealed glass tube a mixture of alcohol and benzoic acid. It is a colorless, oily liquid, with a pleasant aromatic smell and a pungent taste. Sp. gr. 1.051.
Ethyl Bromide, $C_2H_5Br.$	By mixing amorphous phosphorus with absolute alcohol, and adding bromine gradually, then distilling carefully, and washing with a small quantity of solution of soda to remove any free bromine. A transparent and colorless liquid. Sp. gr. 1.40. Very volatile. It has a strong ethereal odor and a pungent taste.
Ethyl Butyrate, $C_2H_5,C_4H_7O_2.$	By heating together a mixture of strong sulphuric acid, butyric acid, and strong alcohol. A transparent, colorless, very thin liquid. It has an odor resembling that of pineapple. Sp. gr. .902.
Ethyl Chloride, $C_2H_5,Cl.$	By saturating absolute alcohol with hydrochloric acid gas, distilling in a water-bath, collecting the distillate in a bottle containing water, then immersing in water surrounded by ice, and, lastly, washing with water to remove free alcohol, then rectifying over magnesia. A thin, colorless liquid, having an ethereal odor, and a sweet, afterwards alliaceous, taste. Very inflammable. Sp. gr. .920.
Ethyl Disulphide, $C_2H_5S.$	By acting upon potassium disulphide in concentrated solution with potassium sulphethylate. A colorless, oily liquid, having a very strong odor and a sharp, sweetish taste.
Ethyl Iodide, $C_2H_5I.$	By acting upon alcohol with iodine and phosphorus. A colorless, volatile liquid, but gradually turning brown in the light. Slightly soluble in water. Sp. gr. 1.946.
Ethyl Pelargonate (Grape Oil), $C_2H_5,C_9H_{17}O_2.$	By adding sulphuric acid and water to wine lees, and distilling in a current of steam. A colorless, mobile liquid, of a strong vinous odor. Almost insoluble in water, but soluble in alcohol. Sp. gr. .860.
Ethyl Sulphydrate (Mercaptan), $C_2H_5,HS.$	By distilling crystallized calcium sulphethylate with a solution of barium sulphydrate, collecting the product in a well-cooled receiver, then decanting the aqueous portion, and purifying the mercaptan by distilling with mercury, and dehydrating by calcium chloride. A colorless, very mobile liquid, having an alliaceous odor.
Ethyl-Sulphuric Acid (Sulphovinic Acid), $C_2H_5,HSO_4.$	By reacting upon sulphuric acid with alcohol. It is found in the preparation of ether.
Ethyl Valerate, $C_2H_5.C_5H_9O_2.$	A colorless liquid, having a fruity odor, also like that of valerian. Sp. gr. .866.
Methyl Acetate, $CH_3,C_2H_3O_2.$	(Prepared by processes similar to those employed for obtaining ethyl acetate, *quod vide.*) It is present to some extent in crude wood naphtha. Sp. gr. .919. Readily soluble in water.
Methyl Chloride, $CH_3Cl.$	By distilling together a mixture of methyl alcohol, sodium chloride, and sulphuric acid. It is a gas at ordinary temperatures, but may be condensed by pressure to a colorless, very mobile liquid. It has an ethereal smell and a sweet taste. Used chiefly as a refrigerating agent.
Methyl Iodide, $CH_3I.$	By distilling 1 part phosphorus, 8 parts iodine, and 12 parts wood spirit, allowing the distillate to pass into a bottle containing water, then rectifying the product in a water-bath over calcium chloride and lead oxide. A colorless liquid. Sp. gr. 2.23.

Unofficinal Ethyl and Amyl Compounds, and Allied Products.—(*Continued.*)

Methylene Chloride, CH_2Cl_2.	By acting upon methylene iodide with chlorine gas. A colorless liquid, with a penetrating odor similar to that of chloroform.
Methylene Iodide, CH_2I_2.	By acting upon sodium ethylate with iodoform. A yellowish, strongly refracting liquid.
Paraldehyd, $C_6H_{12}O_3$.	By acting upon aldehyd with small quantities of mineral acids or zinc chloride; also by adding a few drops of concentrated sulphuric acid to aldehyd. A colorless liquid, soluble in cold water. Used as a hypnotic and anodyne, in doses of ½ to 1½ fl. dr.
Potassium Ethylate, C_2H_5KO.	By treating absolute alcohol with potassium. It crystallizes in colorless crystals.
Potassium Sulphethylate, $KC_2H_5SO_4$.	By acting upon mercaptan with potassium. It is a dull white, granular mass, very soluble in water.
Silver Sulphethylate, $AgC_2H_5SO_4$.	By adding silver nitrate to an aqueous solution of mercaptan and collecting the white precipitate.
Sodium Ethylate, C_2H_5NaO.	By treating absolute alcohol with sodium. It crystallizes in broad laminæ.
Sodium Sulphethylate, $NaC_2H_5SO_4 + H_2O$.	By decomposing barium sulphethylate with sodium carbonate, filtering from the insoluble sodium sulphate formed, and evaporating to crystallization.

CHAPTER LIV.

PRODUCTS OF THE ACTION OF FERMENTS UPON ACID SACCHARINE FRUITS.

THE acid saccharine fruits form an important class in medicine and pharmacy. Their principal constituent is usually a vegetable acid (in some fruits several acids are found); sugar and albuminous principles are present in small amount, and on account of their presence vinous fermentation may be induced in their juices, resulting in the production of important alcoholic liquids. The fruits of this class which contribute the most useful products to pharmacy are grapes, lemons, limes, oranges, apples, tamarinds, raspberries, mulberries, pineapples, strawberries, currants, blackberries, etc. Most of the juices of these fruits readily undergo fermentation: the clear alcoholic liquid left after decomposition has received various names according to the fruit from which it is derived,—viz., wine from grapes, cider from apples, perry from pears, etc.

The products from the grape will be considered first.

VINUM ALBUM. *U.S.* White Wine.

A pale amber-colored or straw-colored, alcoholic liquid, made by fermenting the unmodified juice of the grape, freed from seeds, stems, and skins.

VINUM RUBRUM. *U.S.* Red Wine.

A deep red, alcoholic liquid, made by fermenting the juice of colored grapes in presence of their skins.

The grape is the fruit of *Vitis vinifera;* the juice contains grape-sugar, tannin, acid potassium tartrate, calcium tartrate, potassium sulphate, sodium chloride, pectin, albuminous principles, and water. It will be seen that grape-juice naturally contains all the substances essential to the production of vinous fermentation, a favorable temperature and the presence of the atmosphere being alone needed to convert it into wine.

Preparation.—The grape-juice is run into vats, and constitutes the *must.* The temperature of the air being about 15.6° C. (60° F.), fermentation gradually takes place in the must, which becomes sensibly warmer and emits a large quantity of carbonic acid. The liquor from being sweet becomes vinous, owing to the conversion of the grape-sugar into alcohol. When the liquor has acquired a strong vinous taste and become perfectly clear, the wine is considered formed, and is racked off into casks. But even after this stage of the process the fermentation continues for several months. During the whole of this period a

frothy matter is formed, which for the first few days collects round the bung, but afterwards precipitates along with coloring-matter and tartar, forming a deposit which constitutes the wine-lees. Wines are sweet, dry, light, sparkling, still, acid, or rough, according to the character of the grape-juice and the method employed in making the wine. When the quantity of sugar in the juice is large, and the amount of ferment insufficient to convert all the sugar into alcohol, a *sweet* wine is produced; if, on the other hand, the quantity of ferment is sufficient to convert all the sugar into alcohol, a *strong* or *generous* wine is formed. If only a moderate amount of sugar is present in the juice, with enough ferment to convert all of it into alcohol, the wine is termed *dry*. A small proportion of sugar results in the production of a *light* wine; if a large quantity of ferment is present, however, a *sour* wine is produced, because the fermentation has progressed until acetic acid is formed. Wines are *sparkling* or *still* according as they contain carbonic acid or not, and, if fermented in contact with the seeds which contain tannin, they are *rough* or astringent. Two kinds of wine are officinal,—Vinum album, white wine, and Vinum rubrum, red wine: any of the commercial brands of wine which fulfil the requirements of the Pharmacopœia may therefore be used.

Vinum Album. *U.S.*	Odor, Taste, and Reaction.	Solubility.
White Wine should have a sp. gr. of not less than 0.990, nor more than 1.010.	A pleasant odor, free from yeastiness; a full, fruity, and agreeable taste; without excessive acidity or sweetness.	Miscible in all proportions with water or alcohol.

Alcoholmetric Test.	Impurities.	Test and Limits for Impurities.
Tested by the following method, White Wine should contain not less than 10 per cent., nor more than 12 per cent., by weight, of absolute alcohol. Weigh a definite volume of the Wine at the temperature of 15.6° C. (60° F.); evaporate it in a porcelain capsule to one-third of its original volume, cool, and add distilled water until the mixture measures its original volume at the temperature of 15.6° C. (60° F.); then weigh again. The first weight divided by the second will afford a quotient (to be carried out to four decimal places) which corresponds to the percentage of absolute alcohol, by weight, in the Wine (which may be ascertained by consulting the alcoholmetrical table) (see page 684).	Tannic Acid.	If 10 C.c. of White Wine be diluted with an equal volume of distilled water and treated with 5 drops of test-solution of ferric chloride, only a faint greenish-brown color should make its appearance.
	Limit of Fixed Residue.	Upon evaporation and twelve hours' drying on the water-bath, it should leave a residue of not less than 1.5 per cent. nor more than 3.0 per cent.
	Limit of Acidity.	Using litmus paper as an indicator, 250 C.c. of White Wine should require, for complete neutralization, not less than 15 nor more than 26 C.c. of the volumetric solution of soda.

The explanation of the officinal quantitative test for the amount of alcohol in wine is based upon the assumption that when the alcohol from a measured weight of wine at a given temperature is entirely evaporated without boiling or wasting it, and when the original volume has been exactly restored by the addition of pure water at the same

temperature, if the weight of the wine be divided by that of the liquid which had its volume restored, the quotient will express the *specific gravity* of the mixture of alcohol and water in the wine. By referring to the alcohol table the percentage of alcohol by weight corresponding to this specific gravity is ascertained, and thus the percentage of alcohol in the wine is obtained.

An example will illustrate this. If 6 fl. oz. of the wine to be tested weigh 2727 grains, when it has been evaporated to 2 fl. oz. and the alcohol has all been driven off, and distilled water added to the residuary liquid until its original volume of 6 fl. oz. is restored, it weighs 2789 grains. Now, $\frac{2727}{2789} = 0.9778$, and, consulting the alcohol-metrical table, a mixture of alcohol and water of the sp. gr. 0.9778 is found to contain 15 per cent. of alcohol, which is the percentage by weight that the wine contains.

Vinum Rubrum. *U. S.*	ODOR, TASTE, AND REACTION.	SOLUBILITY.
Red Wine should have a sp. gr. of not less than 0.989, nor more than 1.010.	A pleasant odor, free from yeastiness; a full, fruity, moderately astringent, pleasant taste; without excessive acidity or decided sweetness.	Miscible in all proportions with water or alcohol.

QUANTITATIVE TEST.	IMPURITIES.	TESTS FOR IMPURITIES AND ALCOHOL TEST.
If 10 C.c. of Red Wine be diluted with an equal volume of distilled water, and treated with 5 drops of test-solution of ferric chloride, the liquid should acquire a brownish-green color, due to tannic acid. Upon evaporation and twelve hours' drying on the water-bath, it should leave a residue of not less than 1.6 per cent., nor more than 3.5 per cent. With test-solution of acetate of lead, Red Wine should form a heavy precipitate, which may vary in color from bluish-green to green.	Limit of Acidity.	Using litmus paper as an indicator, 250 C.c. of Red Wine should require, for complete neutralization, not less than 15 nor more than 26 C.c. of the volumetric solution of soda.
	Aniline Coloring.	If 50 C.c. of Red Wine be treated with a slight excess of water of ammonia, the liquid should acquire a green or brownish-green color; if it be then well shaken with 25 C.c. of ether, the greater portion of the ethereal layer removed and evaporated in a porcelain capsule with excess of acetic acid and a few fibres of uncolored silk, the latter should not acquire a crimson or violet color.
	Amount of Alcohol.	Tested by the method given above under White Wine, Red Wine should contain not less than *ten per cent.*, nor more than *twelve per cent.*, by weight, of absolute alcohol.

The aroma of wines, termed their "bouquet," depends upon the formation of certain compound ethers during the fermentation, and also during the ageing or ripening process. These are said to be *œnanthic, caprylic, butyric, caproic, acetic,* and *pelargonic ethers.*

Argols.—During the fermentation of wines, especially those that are acid, a peculiar matter is deposited upon the sides and bottom of the casks, forming a crystalline crust, called *crude tartar*, or *argols.* That deposited from red wines is of a reddish color, and is called *red argols;* that derived from white wines is of a dirty-white color, and is denominated *white argols.* Both kinds consist of potassium acid tartrate rendered impure by calcium tartrate, more or less coloring-matter, and

other matters which are deposited during the clarification of the wine. The deposition of the tartar is thus explained: the acid tartrate exists naturally in the juice of the grape, held in solution by the sweet aqueous liquid; when the juice is submitted to fermentation in the process for converting it into wine, the sugar disappears, and is replaced by alcohol, in which the salt is insoluble. It is from this substance that potassium acid tartrate is obtained by a process of purification (see Potassii Bitartras, page 453), and from the latter tartaric acid is produced.

Uses.—Wine is used, pharmaceutically, as a menstruum (see Vinum Album Fortius, page 323), the present requirements being that it shall contain at least 20 per cent., but not more than 25 per cent., by weight, of absolute alcohol. This insures greater stability in the medicated wines. Medicinally, wine is used as a stimulant.

SPIRITUS VINI GALLICI. *U. S.* Brandy.

An alcoholic liquid obtained by the distillation of fermented grapes, and at least four years old.

Brandy varies in quality according to the source from which it is obtained. The best brandy is obtained from French wines, and the kind called Cognac is most esteemed. Very large quantities of brandy are now made in California, but the taste is peculiar and easily distinguished from that of Cognac. The Pharmacopœia recognizes all spirits when obtained from the juice of grapes, if sufficiently strong and pure to meet the tests given below.

Spiritus Vini Gallici. *U. S.*	Impurities.	Tests for Impurities.
Brandy has a pale amber color, a distinctive taste and odor, and a sp. gr. not above 0.941 nor below 0.925, corresponding approximately with an alcoholic strength of 39 to 47 per cent. by weight, or 46 to 55 per cent. by volume.	Fusel Oil from grain or potato spirit.	If 100 C.c. of Brandy be very slowly evaporated in a weighed capsule, on a water-bath, the last portions volatilized should have an agreeable odor, free from harshness.
	An undue amount of Solids.	The residue, dried at 100° C. (212° F.), should weigh not more than 0.250 Gm., equivalent to 0.25 per cent.
	Added Sugar, Glycerin, or Spices.	This residue should have no sweet or distinctly spicy taste.
	Traces of Oak Tannin from casks.	The residue should nearly all dissolve in 10 C.c. of cold water, forming a solution which is colored light green by a dilute solution of ferric chloride.
	An undue amount of Free Acid.	100 C.c. of Brandy should be rendered distinctly alkaline to litmus by 3 C.c. of the volumetric solution of soda.

Brandy owes its aroma to œnanthic and acetic ethers and other volatile products. (See Vinum Album.) Œnanthic ether is known chemically as ethyl pelargonate, $C_{11}H_{22}O_2$, but in commerce it is called *oil of cognac*. It is a fragrant, ethereal oil, of a greenish color, and is largely used in making factitious brandy.

Uses.—Brandy is not used in any officinal preparation. It is employed as a stimulant, and often administered with milk, yolk of eggs, etc.

ACIDUM TARTARICUM. *U.S.* Tartaric Acid.

$H_2C_4H_4O_6$; 150.

Preparation.—This important acid may be prepared by saturating the excess of acid in acid potassium tartrate or cream of tartar with calcium carbonate, and decomposing the resulting insoluble calcium tartrate by sulphuric acid, which precipitates in combination with the lime as calcium sulphate, and liberates the tartaric acid. The process, when thus conducted, furnishes only one-half of the tartaric acid. The other half may be procured by decomposing the neutral potassium tartrate remaining in the solution after the precipitation of the calcium tartrate by calcium chloride in excess. By double decomposition, potassium chloride will be formed in solution, and a second portion of calcium tartrate will precipitate, which may be decomposed by sulphuric acid together with the first portion.

$$\underset{\text{Acid Potassium Tartrate.}}{2KHC_4H_4O_6} + \underset{\text{Calcium Carbonate.}}{CaCO_3} = \underset{\text{Potassium Tartrate.}}{K_2C_4H_4O_6} + \underset{\text{Calcium Tartrate.}}{CaC_4H_4O_6} + \underset{\text{Water.}}{H_2O} + \underset{\text{Carbon Dioxide.}}{CO_2};$$

then

$$\underset{\text{Potassium Tartrate.}}{K_2C_4H_4O_6} + \underset{\text{Calcium Chloride.}}{CaCl_2} = \underset{\text{Calcium Tartrate.}}{CaC_4H_4O_6} + \underset{\text{Potassium Chloride.}}{2KCl},$$

and

$$\underset{\text{Calcium Tartrate.}}{2CaC_4H_4O_6} + \underset{\text{Sulphuric Acid.}}{2H_2SO_4} = \underset{\text{Calcium Sulphate.}}{2CaSO_4} + \underset{\text{Tartaric Acid.}}{2H_2C_4H_4O_6};$$

Calcium sulphate is sometimes substituted for calcium chloride in the second stage of the decomposition. Tartaric acid is a dibasic acid, one or two of its hydrogen atoms are capable of being replaced by metals; with monad metals, acid, neutral, and double tartrates may be formed, thus:

$C_4H_4O_6H_2$	$C_4H_4O_6HK$	$C_4H_4O_6K_2$	$C_4H_4O_6KNa.$
Tartaric Acid.	Acid Potassium Tartrate.	Neutral Potassium Tartrate.	Potassio-Sodium Tartrate.

Tartaric acid contains no water of crystallization. The tartrates are important salts; six are officinal, four of them being double salts, viz., tartrate of antimony and potassium, tartrate of iron and potassium, tartrate of iron and ammonium, tartrate of potassium and sodium; the other two salts are tartrate of potassium and bitartrate of potassium. Tartrates may be recognized by becoming blackened on the addition of sulphuric acid, evolving at the same time an empyreumatic odor: their solutions, if neutral, yield with calcium chloride white precipitates of calcium tartrate, which are soluble in potassium hydrate. Tartaric acid is recognized by a strong solution producing with a solution of potassium hydrate a white crystalline precipitate of acid potassium tartrate.

Acidum Tartaricum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Nearly or entirely colorless, transparent, monoclinic prisms, permanent in air. When heated for two hours at 100° C. (212° F.), the crystals do not lose more than a trace in weight. On ignition they should not leave more than 0.05 per cent. of ash.	Odorless; purely acid taste; acid reaction.	Cold. 0.7 part. Boiling. 0.5 part.	Cold. 2.5 parts. Boiling. 0.2 part.	36 parts of absolute alcohol, 23 parts of ether, and 250 parts of absolute ether; nearly insoluble in chloroform, benzol, and benzin.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
An aqueous solution of 1 part of Tartaric Acid in 3 parts of cold water, when mixed with a solution of 1 part of acetate of potassium in 3 parts of cold water, followed by the addition of a volume of alcohol equal to the whole mixture, yields a white, crystalline precipitate. If, after standing two hours at the ordinary temperature, the liquid is separated by filtration and the precipitate well washed with diluted alcohol and dried at 100° C. (212° F.) in an air-bath, it should weigh between 1.25 and 1.26 parts.	Lead and Copper.	A concentrated aqueous solution of Tartaric Acid should not be blackened, at the line of contact, by the careful addition of test-solution of hydrosulphuric acid.
	Lead, Copper, and Iron.	If the crystals have left, on ignition, some ash, this ash, by treatment with a few drops of water of ammonia and one drop of test-solution of sulphide of ammonium, should not cause any black coloration.
	Copper.	If the crystals of Tartaric Acid have left, on ignition, some ash (see above), this ash should not turn blue by treatment with a few drops of water of ammonia.
To neutralize 3.75 Gm. of Tartaric Acid should require 50 C.c. of the volumetric solution of soda.	Sulphuric Acid.	10 C.c. of a concentrated solution of Tartaric Acid should show no precipitate within five minutes after the addition of 1 C.c. of test-solution of chloride of barium with an excess of hydrochloric acid.

Officinal Preparation containing Tartaric Acid.

Pulvis Effervescens Compositus (Compound Effervescing Powder (Seidlitz Powder)). Prepared by wrapping 35 grains of powdered tartaric acid in white paper, and 160 grains of Seidlitz mixture (composed of 40 grains of sodium bicarbonate and 120 grains of Rochelle salt) in blue paper. (See Pulveres.)

LIMONIS SUCCUS. *U.S.* Lemon-Juice.

The freshly expressed juice of the ripe fruit of *Citrus Limonum* Risso (Nat. Ord. *Aurantiaceæ*).

Lemon-juice owes its acidity to citric acid (see Acidum Citricum). It is a yellowish, slightly turbid, acid liquid, having a slight odor of lemon, due to the presence of a trace of the volatile oil of the rind. Its specific gravity should be not less than 1.030, and it should contain about 7 per cent. of citric acid. Lemon-juice can only with difficulty be preserved. It is generally heated so as to coagulate albuminous matter, and then a small quantity of alcohol is added as an antiseptic.

Officinal Preparations.

Syrupus Limonis (Syrup of Lemon) . . . . . Made by heating 40 parts of lemon-juice to boiling, adding 2 parts of fresh lemon peel, 60 parts of sugar, and sufficient water to make 100 parts (see page 265).

Mistura Potassii Citratis (Mixture of Citrate of Potassium) . . . . Made by neutralizing fresh lemon-juice with bicarbonate of potassium (see page 274).

ACIDUM CITRICUM. *U.S.* Citric Acid.

$H_3C_6H_5O_7.H_2O$; 210.

Preparation.—Although this acid is found in many plants, it is obtained upon a commercial scale only from the juice of limes and lemons. It is extracted from lime-juice by a very simple process, but one requiring some careful manipulation. The boiling juice is first completely saturated with calcium carbonate (chalk or whiting) in fine powder, and the calcium citrate formed is allowed to subside. This is then washed repeatedly with water, and decomposed by diluted sulphuric acid. An insoluble calcium sulphate is precipitated, and the disengaged citric acid remains in solution. This is carefully concentrated in leaden boilers until a pellicle begins to form, when it is transferred to other vessels to cool and crystallize.

$$\underset{\text{Citric Acid in Lime-Juice.}}{2H_3C_6H_5O_7} + \underset{\text{Calcium Carbonate.}}{3CaCO_3} = \underset{\text{Calcium Citrate.}}{Ca_3 2C_6H_5O_7} + \underset{\text{Water.}}{3H_2O} + \underset{\text{Carbon Dioxide.}}{3CO_2};$$

then

$$\underset{\text{Calcium Citrate.}}{Ca_3 2C_6H_5O_7} + \underset{\text{Sulphuric Acid.}}{3H_2SO_4} = \underset{\text{Citric Acid.}}{2H_3C_6H_5O_7} + \underset{\text{Calcium Sulphate.}}{3CaSO_4}.$$

Acidum Citricum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Colorless, right-rhombic prisms, not deliquescent except in moist air, efflorescent in warm air.	Odorless; agreeable acid taste; acid reaction.	Cold. 0.75 part. Boiling. 0.5 part.	Cold. 1 part. Boiling. 0.5 part.	Ether 48 parts; nearly insoluble in absolute ether, chloroform, benzol, and benzin.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
When heated to 100° C. (212° F.), the Acid melts and gradually loses 8.6 per cent. of its weight. At a higher temperature it emits inflammable vapors, chars, and is finally dissipated without leaving more than 0.05 per cent. of ash. On adding an aqueous solution of the Acid to an excess of lime-water, the mixture remains clear until boiled, when a white precipitate separates, which is nearly all redissolved on cooling. To neutralize 3.5 Gm. of the Acid should require 50 C.c. of the volumetric solution of soda.	Tartaric and Oxalic Acids.	If 1 part of the Acid be dissolved in 2 parts of water and treated with a solution of 1 part of acetate of potassium in 2 parts of water, the mixture should remain clear after the addition of an equal volume of alcohol.
	1 per cent. or more of Tartaric Acid.	If 1 Gm. of the Acid be dissolved, without heat, in 10 C.c. of a cold, saturated solution of bichromate of potassium, no darkening of the liquid should be observed within five minutes.
	Lead or Copper.	An aqueous solution of the Acid should not be darkened nor be precipitated by hydrosulphuric acid.
	Copper.	If the crystals have left, on ignition, some ash, this ash should not turn blue by treatment with a few drops of water of ammonia.
	Lead, Copper, and Iron.	Nor should the further addition of one drop of test-solution of sulphide of ammonium cause any black coloration.
	Sulphuric Acid.	10 C.c. of a concentrated solution should show no precipitate within five minutes after the addition of 1 C.c. of test-solution of chloride of barium with excess of hydrochloric acid.

Citric acid contains one molecule of water of crystallization: it differs in this respect from tartaric acid, which contains none. It is a tribasic acid; in other words, three atoms of hydrogen are replaceable by metals, three classes of citrates being formed according as one, two, or three hydrogen atoms are replaced.

The citrates are a valuable class of medicinal salts, nine being officinal,—four are simple salts and four are double,—as follows: citrates of bismuth, iron, lithium, and potassium, granulated citrate of magnesium, citrate of bismuth and ammonium, citrate of iron and ammonium, citrate of iron and quinine, citrate of iron and strychnine. It is used in four solutions,—solution of citrate of iron, solution of citrate of iron and quinine, solution of citrate of magnesium, solution of citrate of potassium.

Uses.—Citric acid in solution is used as a substitute for lemon-juice. The dose is from five to thirty grains. It is rarely given in its free state.

Officinal Preparation.

Syrupus Acidi Citrici. Syrup of Citric Acid. Made by mixing 4 parts of spirit of lemon with 980 parts of syrup, adding gradually a solution of 8 parts of citric acid in 8 parts of water (see page 259).

TAMARINDUS. *U. S.* Tamarind.

The preserved pulp of the fruit of *Tamarindus indica* Linné (Nat. Ord. *Leguminosæ*, *Cæsalpinieæ*).

Among the constituents of the pulp of tamarinds are citric and tartaric acids: malic acid is present in small quantity.

Uses.—This pulp is one of the ingredients in confection of senna: it is purgative, and is often used to make laxative confections.

RHUS GLABRA. *U. S.* Rhus Glabra. [RHUS GLABRUM, Pharm. 1870. SUMACH.]

The fruit of *Rhus glabra* Linné (Nat. Ord. *Terebinthaceæ*, *Anacardieæ*).

This fruit owes its acidity to malic acid, which exists in it as calcium and potassium malate: this acid is found in unripe apples and in a great number of fruits, roots, leaves, stems, etc. Rhus glabra also contains tannin, gallic acid, and red coloring-matter.

Malic acid may be obtained from rhus glabra by exhausting the berries with water, evaporating, filtering, and crystallizing the acid calcium malate, which is then dissolved in boiling water, and treated with lead acetate, when lead malate is precipitated; this is then suspended in water, hydrosulphuric acid passed through it, lead sulphide precipitated, and the solution of malic acid evaporated to permit crystallization. Malic acid is found in colorless shining needles having a sour taste and an acid reaction. It is soluble in alcohol and deliquescent in the air. It is dibasic.

Uses.—Rhus glabra is a useful refrigerant and astringent. The dose is thirty grains to two drachms.

Officinal Preparation.

Extractum Rhois Glabræ Fluidum. Fluid Extract of Rhus Glabra. Made with 10 per cent. of glycerin and a menstruum of diluted alcohol (see page 357).

Acid Saccharine Fruits containing Pectinous Bodies.

The pulpy constituents of fruits and fleshy roots undergo naturally certain changes when subjected to the influences of a ferment known as *pectase:* these changes can be closely imitated artificially when the pulp is treated with acids or alkalies in aqueous solution, by the aid of heat. According to Fremy, pectase exists in fruits in either a soluble or an insoluble condition. Green unripe fruits contain *pectose*, a substance which is supposed to be isomeric with cellulin, and which gives to such fruits their hardness. Pectose is insoluble in water, alcohol, or ether.

In the process of ripening fruits, the pectase slowly acts on the pectose, the hardness disappears, *pectin* is formed, and the fruit is soft and ripe. When it is overripe, *parapectin* and *metapectic acid* are produced. The moderate action of heat and water upon fruits is thus explained: the citric, tartaric, or malic acid in the fruit acts on the pectose, softening it, and converting it into pectin, and the pectin is then acted upon by the ferment pectase, which causes it to gelatinize, on cooling, through the production of pectosic acid: this is the cause of the formation of fruit jellies. The *rapid* application of strong heat to the pulp of fruits results in the coagulation and destruction of the ferment pectase, and the production of jelly is thus prevented.

Alkalies form soluble compounds with pectosic acid and pectin, and hence, when gelatinous precipitates are found in fluid extracts and tinctures, due to the formation of either of these substances, they may be dissolved by the application of an alkaline solution: the use of water of ammonia in fluid extract of senega is an illustration of this.

Officinal Preparation of Pectinous Fruit.

Syrupus Rubi Idæi. Syrup of Raspberry. Express the juice from fresh ripe raspberries, allow it to stand until it ferments, then filter it, and add 60 parts of sugar to 40 parts of the filtered liquid, heat to boiling, and strain (see page 266).

Unofficinal Fruits.

Apple. The fruit of *Pyrus malus*. The constituents are 7 to 10 per cent. sugar, ½ to 1 per cent. free acid, and 5 per cent. each albuminous and pectinous substances. The fermented juice of the apple is termed *cider* or *vinegar*.

Apricot. The fruit of *Prunus Armeniaca*. The average constituents are 1 to 2 per cent. sugar, ½ to 1 per cent. free acid, ½ to 1 per cent. albuminous substances, and 5 to 10 per cent. pectinous substances.

Blackberry. The fruit of *Rubus villosus, R. canadensis*, and *R. trivialis*. The average constituents are 4 per cent. sugar, 1 per cent. free acid, ½ per cent. albuminous substances, and 1 to 1½ per cent. pectinous substances.

Bilberry. The fruit of *Vaccinium resinosum*. The average constituents are 5 per cent. sugar, 1 per cent. free acid, 1 per cent. albuminous substances, and ½ per cent. pectinous substances.

Cherry. The fruit of a species of *Prunus*. The average constituents are 8 to 13 per cent. sugar, 1 per cent. free acid, and ½ to 3 per cent. each albuminous and pectinous substances.

Currant. The fruit of *Ribes rubrum*. The average constituents are 4 to 7 per cent. sugar, 1 to 2 per cent. free acid, ¼ to ½ per cent. albuminous substances, and ½ per cent. pectinous substances.

Gooseberry. The fruit of *Ribes Grossularia*. The average constituents are 6 to 8 per cent. sugar, 1 to 1½ per cent. free acid (chiefly citric), ½ per cent. albuminous substances, and ½ to 2 per cent. pectinous substances.

Peach. The fruit of *Amygdalus Persica*. The average constituents are 1½ per cent. sugar, ½ per cent. free acid, ½ per cent. albuminous substances, and 6 per cent. pectinous substances.

Unofficinal Fruits.—(*Continued.*)

Pear.	The fruit of *Pyrus communis*. The average constituents are 7 per cent. sugar, 7 per cent. free acid, ¼ per cent. albuminous substances, and 3 per cent. pectinous substances.
Pineapple.	The fruit of *Bromelia Ananas*. The juice contains 2 per cent. sugar, 1 per cent. free acid, and 3 per cent. albuminous and pectinous substances.
Plum.	The fruit-trees belonging to the genus *Prunus*. The average constituents are about 1 to 2 per cent. sugar, ½ to 1 per cent. free acid, ½ per cent. albuminous substances, and 2 to 11 per cent. pectinous substances.
Strawberry.	The fruit of different species of *Fragaria*. The average constituents are 3 to 7 per cent. sugar, 1 per cent. free acid, ½ per cent. albuminous substances, and 2 per cent. pectinous substances.

CHAPTER LV.

VOLATILE OILS.

VOLATILE oils, or *essential oils*, are found in the various parts of plants. They usually constitute the odorous principles, and they either pre-exist in the plant, or are produced by the reaction of certain constituents when brought in contact with water. Volatile oils are sometimes formed through destructive distillation, as the oil of amber, and may also be obtained from the animal kingdom, as the oil from ambergris. They may be divided into four classes: 1. Terpenes. 2. Oxygenated oils. 3. Sulphurated oils. 4. Nitrogenated oils.

1. **Terpenes**, or hydrocarbons, consist of carbon and hydrogen, and mostly have the formula $C_{10}H_{16}$, oil of turpentine being the type.

2. **Oxygenated Oils.**—Hydrocarbons containing oxygen, like the oil of cinnamon.

3. **Sulphurated Oils.**—Containing sulphur, like the volatile oil from mustard.

4. **Nitrogenated Oils.**—A very small class containing hydrocyanic acid, like oil of bitter almond; otherwise, nitrogen is never one of the constituents of volatile oils.

Proximately, volatile oils consist of two principles, which differ in their point of volatilization or congelation, or in their composition. They are termed *stearopten* and *eleopten*. It is, however, impossible to separate these by distillation alone so as to obtain them entirely pure. When, as often happens, they congeal at different temperatures, they may be separated by compressing the frozen oil between folds of bibulous paper. The solid matter, stearopten, remains within the folds, and the fluid, eleopten, is absorbed by the paper, from which it may be separated by distillation with water. The solid crystalline substances deposited by volatile oils upon standing are also called stearoptens. Some of them are denominated *camphors*, from their resemblance to true camphor. Some are isomeric with the oils in which they are formed; others are oxides or hydrates, alcohol-like in character. Certain oils, under the influence of water, deposit crystalline hydrates of the respective oils.

Color of Volatile Oils.—Most oils are colorless when pure and fresh, or can be made colorless by redistillation. Upon exposure to the air they acquire various colors, becoming green, as in oil of wormwood, yellow, as in oil of peppermint, red, as in oil of origanum, brown, as in oil of cinnamon, or blue, as in oil of chamomile.

Odor.—The odor of volatile oils is very variable. It is their most characteristic feature. It is sensibly modified by the exposure of the

oils to the air. Oil of turpentine may be rectified by distillation in an atmosphere of carbonic acid, or *in vacuo*, so that it will be odorless, or have an agreeable fragrant odor. A very slight exposure to the air is sufficient, however, to restore the well-known unpleasant odor.

Taste.—Their taste is almost as variable as their odor. Some are sweet, others have a mild, pungent, hot, acrid, caustic, or burning taste.

Density.—The specific gravity of volatile oils also varies (from 0.847 to 1.17). They are mostly lighter than water (see table, page 76).

Boiling Point.—This is also variable. The oils volatilize to some extent at ordinary temperatures and diffuse their peculiar odors. Upon heating, however, they may be completely vaporized. When sufficiently heated, they take fire, and burn with a bright flame.

Solubilities.—Water is a poor solvent for volatile oils, although it acquires a decided odor and flavor when brought in contact with the oil in a finely-divided state, as has been shown in the medicated waters. Alcohol, ether, chloroform, naphtha, benzin, and benzol are good solvents for volatile oils. Alcohol is a better solvent for the oxygenated oils than for the terpenes. Volatile oils freely dissolve fixed oils, fats, resins, camphors, sulphur, phosphorus, and similar bodies.

Exposure to Light and Air injures the quality and destroys the fragrance of volatile oils. Ozone is developed, and they thicken and become resinified, or deposit crystalline compounds upon exposure. The whitening of corks which have been inserted in bottles containing volatile oils and kept a long time is due to the bleaching action of the ozone which is gradually produced during their decomposition. They should be kept in tightly-stoppered, amber-colored vials.

Action of Acids, Alkalies, etc.—Nitric acid, if strong, decomposes volatile oils with great rapidity. Iodine reacts with some oils with explosive violence. Alkalies have generally little effect on volatile oils, with the exception of a few with which it forms chemical compounds, like the oils from cloves, gaultheria, cinnamon, etc.

Adulterations.—The volatile oils are costly enough to tempt the cupidity of those who make a business of adulterating. A fixed oil is sometimes used to mix with the volatile oil. This mixture may be detected by dropping the suspected oil on a piece of filtering-paper. The stain of a pure volatile oil is not permanent. By slightly heating it the oil is vaporized; if fixed oil is present, the stain remains. Alcohol may be detected by shaking the mixed oil in a graduated tube with glycerin or water. The volume of the oil will be diminished, and that of the water or glycerin correspondingly increased, in proportion to the amount used. This test is not susceptible of fine determination, because of the slight solubility of volatile oils in water and in mixtures of alcohol and water. If a large quantity of alcohol has been added, it may be shown by setting fire to a small portion in a dish in a dark room, when the lambent blue flame of burning alcohol will be seen. Volatile oils burn with a yellow, sooty flame. Metallic sodium, calcium chloride, aniline red, have all been used to show the presence of alcohol and traces of water in volatile oils. The adulteration of volatile oils by the addition of cheaper grades of the same oil, or by using a cheaper oil having a similar odor, is largely practised. The only

reliable test here is the use of the olfactories. By practice the sense of smell can be cultivated so that most adulterations of this kind can be detected.

Preparation of Volatile Oils.

Volatile oils are generally obtained from plants by the following methods: 1. Distillation with water. 2. Distillation *per se*. 3. Expression. 4. Solution.

1. **Distillation with Water.**—This is the method most frequently employed. The general formula is as follows: Put the substance from which the Oil is to be extracted into a still (see Distillation, page 135), and add enough water to cover it; then distil by a regulated heat into a large refrigeratory. Separate the Distilled Oil from the water which comes over with it.

The substances from which the volatile oils are extracted may be employed in either the recent or the dried state. Certain flowers, however, such as orange flowers and roses, must be used fresh, or preserved with salt or by means of glycerin, as they afford little or no oil after desiccation. Dried substances, before being submitted to distillation, require to be macerated in water till they are thoroughly penetrated by this fluid; and, to facilitate the action of the water, it is necessary that, when of a hard or tough consistence, they should be properly comminuted.

The water which is put with the substance to be distilled into the still, answers the double purpose of preventing the decomposition of the vegetable matter by regulating the temperature, and of facilitating the volatilization of the oil, which, though in most instances it readily rises with the vapor of boiling water, requires, when distilled alone, a considerably higher temperature, and is at the same time liable to be partly decomposed. Some oils, however, will not ascend readily with steam at 100° C. (212° F.), and in the distillation of these it is customary to use water saturated with common salt, which does not boil under 110° C. (230° F.) (see page 100). Other oils, again, may be volatilized with water at a temperature below the boiling point; and, as heat exercises an injurious influence over the oils, it is desirable that the distillation should be effected at as low a temperature as possible. To prevent injury from heat, it has been recommended to suspend the substance containing the oil in a basket, or to place it upon a perforated shelf, in the upper part of the still, so that it may be penetrated by the steam without being in direct contact with the water. Another mode of effecting the same object is to distil it *in vacuo*. Steam can be very conveniently applied to this purpose by causing it to pass through a coil of tube, of an inch or three-quarters of an inch bore, placed in the bottom of a common still (see page 106). The end at which the steam is admitted enters the still at the upper part, and the other end, at which the steam and condensed water escape, passes out laterally below, being furnished with a stop-cock, by which the pressure of the steam may be regulated, and the water drawn off when necessary. In some instances it is desirable to conduct the steam immediately into the still near the bottom, by which the contents are kept in a state of brisk ebullition (see Fig. 92).

The quantity of water added is not a matter of indifference. An

amount above what is necessary acts injuriously, by holding the oil in solution, when the mixed vapors are condensed; and, if the proportion be very large, it is possible that no oil whatever may be obtained separate. On the contrary, if the quantity be too small, the whole of the oil will not be distilled, and there will be danger of the substance in the still adhering to the sides of the vessel and thus becoming burnt. The cage shown on page 137 will be found useful in this connection. Enough water should always be added to cover the solid material and prevent the latter accident. Dried plants require more water than fresh and succulent ones. Sometimes the quantity of oil is so small, and it is so soluble, that it entirely dissolves in the water, and then the process of *cohobation* is applicable: this consists in repeatedly returning the distillate to a fresh portion of the plant, the water in this way becoming saturated, and then the oil can be collected and separated. Separatory funnels may be used for this purpose (see page 200).

When first procured, the oils have a disagreeable empyreumatic odor, from which they may be freed by allowing them to stand for some days in vessels loosely covered with paper. They should then be filtered and introduced into small amber-glass bottles, which should be well stopped so as to exclude the air. When altered by exposure to air, they may be apparently restored to their former appearance and quality by agitation with a little recently heated animal charcoal. Such oils are, however, never equal to the originals, having lost considerable of their freshness and agreeable odor.

2. **Distillation** *per se*.—By this is meant the distillation of certain bodies without the use of water (*per se*, "by itself"). This is done in the cases of certain oleoresins, oils, copaiba, etc., water not being required in the process, and always being difficult to separate from the distillate.

3. **Expression** (see page 219).—This method generally produces the most fragrant products, because there are very few volatile oils whose aroma is not injuriously affected by the action of heat. Expressed oils, however, have the disadvantage of usually containing a small quantity of albuminous matter, which renders them slightly turbid, and interferes with their keeping qualities. The volatile oils of the Aurantiaceæ are mostly made by expressing the rind of the fresh fruit (see page 717).

4. **Solution or Absorption.**—Some volatile oils are so susceptible to decomposition that they are dissociated by distillation, whilst they do not exist in sufficient quantity in the plant to pay for their extraction by expression: in such cases the odorous principle may be extracted by some form of solution or absorption. This may be effected by maceration, digestion, percolation with carbon bisulphide or similar solvent, enfleurage, or the pneumatic process.

Maceration.—In obtaining volatile oils by maceration, the odorous portions of the plant (generally fragrant flowers) are allowed to stand in contact with a bland, inodorous fixed oil, like fine olive oil, oil of ben, or purified cotton-seed oil: the oil absorbs the odor, and after a certain length of time it is strained. The odorous fixed oil is generally used in perfumery.

Digestion.—This process is similar to maceration, except that a moderate heat is employed, by the use of a salt-bath, to aid in the extraction.

Enfleurage is largely used for extracting the odors of very delicate flowers. It is a cold process, and consists in spreading a thin layer of purified inodorous fat upon glass frames (*châssis*): these resemble an ordinary window-sash, with one pane of glass in each. The flowers are sprinkled on the fat, and the frames piled in a stack. The whole is left undisturbed for a time varying from twelve hours to four days. The fat absorbs the odor completely. When strong pomades are desired, fresh flowers are continually added as long as the absorption continues, and the pomades are known commercially as Nos. 6, 12, 18, and 24, the numbers indicating the strength. The volatile products may be obtained from the pomade by chopping the latter into small pieces and macerating them in pure alcohol. A small portion of the fat is apt to be dissolved by this treatment and give a fatty odor to the solution, but this may be separated by subjecting it to cold, when it can be filtered out.

Pneumatic Process.—This method is used only with very delicate volatile oils. It consists in forcing a current of air into a vessel filled with fresh flowers, and then conveying the perfumed air into another vessel containing purified fat which is kept melted. Circular plates, half immersed, revolve in the fat, and these, when coated, absorb the odor from the perfumed air.

Percolation.—This process consists in percolating odorous flowers with purified carbon disulphide: the latter is distilled, and the volatile oils are found in the residue.

Officinal Products from the Aurantiaceæ.

The natural order Aurantiaceæ furnishes valuable products to medicine and pharmacy, which are conveniently grouped together.

AURANTII DULCIS CORTEX. *U. S.* Sweet Orange Peel.

The rind of the fruit of *Citrus Aurantium* Risso (Nat. Ord. *Aurantiaceæ*).

Sweet orange peel owes its virtues to the volatile oil found in the epidermis. It also communicates a yellowish color to the preparations made with it. It is used as a flavoring substance.

Officinal Preparations.

Syrupus Aurantii . . . . . Made by macerating sweet orange peel with a little alcohol, making a medicated water by the aid of precipitated calcium phosphate, and dissolving sugar in it by agitation (see page 261).
Syrup of Orange.

Tinctura Aurantii Dulcis . . . . Made by percolating 20 parts of sweet orange peel with sufficient alcohol to make 100 parts (see page 305). Dose, one fluidrachm.
Tincture of Sweet Orange Peel.

AURANTII AMARI CORTEX. *U. S.* Bitter Orange Peel.

The rind of the fruit of *Citrus vulgaris* Risso (Nat. Ord. *Aurantiaceæ*).

The peel from the bitter orange contains *hesperidin* and a small quantity of volatile oil. It is not used to communicate flavor, but as a bitter tonic. The dose is ten to forty grains.

Officinal Preparations.

Extractum Aurantii Amari Fluidum . Made with a menstruum of 2 parts of alcohol and 1 part of water (see page 337). Dose, half a fluidrachm.
Fluid Extract of Bitter Orange Peel.

Tinctura Aurantii Amari . . . . . Made by exhausting 20 parts of bitter orange peel with sufficient diluted alcohol to make 100 parts (see page 305). Dose, one to two fluidrachms.
Tincture of Bitter Orange Peel.

OLEUM AURANTII CORTICIS. *U. S.* Oil of Orange Peel.

A volatile oil extracted by mechanical means from fresh Orange Peel.

This oil is of a pale yellowish color, and has the composition of the terpenes, $C_{10}H_{16}$. Its sp. gr. is 0.860. It is soluble in alcohol, and may be preserved by shaking it with one-fourth of its volume of water, separating, and mixing with five times its measure of alcohol. It is very prone to decomposition, and rapidly acquires a terebinthinate odor. It is used in making cologne water and bay rum, and to flavor elixirs.

Officinal Preparations.

Elixir Aurantii . . Made by dissolving 1 part of oil of orange peel and 100 parts of sugar in 200 parts of a mixture consisting of 50 parts of alcohol and 150 parts of water (see page 283).
Elixir of Orange.

Spiritus Aurantii . Made by dissolving 6 parts of oil of orange peel in 94 parts of alcohol (see page 280). Dose, one fluidrachm.
Spirit of Orange.

AURANTII FLORES. *U.S.* Orange Flowers.

The partly expanded, fresh flowers of *Citrus vulgaris* and *Citrus Aurantium* Risso (Nat. Ord. *Aurantiaceæ*).

Orange flowers afford a number of agreeable flavoring and odorous products, of which the oil and the distilled water are the most useful. When it is desired to keep fresh orange flowers for some time, they may be preserved by mixing them well with half their weight of chloride of sodium, pressing the mixture in a suitable jar, and keeping it, well closed, in a cool place.

Officinal Preparation.

Aqua Aurantii Florum . Made by distilling 100 parts of water from 40 parts of recent orange flowers (see page 249).
Orange Flower Water.

OLEUM AURANTII FLORUM. *U.S.* Oil of Orange Flowers. [Oil of Neroli.]

A volatile oil distilled from fresh Orange Flowers.

This is a brownish-yellow, very fragrant terpene ($C_{10}H_{16}$). Sp. gr. 0.850 to 0.890. It is soluble in an equal weight of alcohol, and is well preserved by this addition. If a little alcohol be poured on the surface of the oil and the mixture gently undulated, a bright violet fluorescence will be observed. This oil as found in the market is very variable in quality. The best comes from Nice, and is derived from the flowers of the *Citrus Aurantium*, or sweet orange, by distillation with water: this is called *neroli pétale*. The next quality is obtained in the same way, but by using the blossoms of the *Citrus Bigaradia*, or bitter orange: this is called *neroli bigarade*. An inferior sort, *essence de petit grain*, is made by distilling the leaves and unripe fruit.

Uses.—This oil is almost exclusively used in perfumery.

LIMONIS CORTEX. *U.S.* **Lemon Peel.**

The rind of the recent fruit of *Citrus Limonum* Risso (Nat. Ord. *Aurantiaceæ*).

Lemon peel is principally used to communicate flavor and color to spirit and syrup of lemon. It contains volatile oil and *hesperidin*.

OLEUM LIMONIS. *U.S.* **Oil of Lemon.**

A volatile oil extracted by mechanical means from fresh Lemon Peel.

This important volatile oil is a terpene, $C_{10}H_{16}$: when fresh it has the fragrant odor of lemons. Sp. gr. 0.850. It is soluble in two parts of alcohol, and in all proportions in absolute alcohol or carbon disulphide. It may be preserved from the effects of oxidation by the addition of 5 per cent. of alcohol and separating from the sediment.

Officinal Preparation.

Spiritus Limonis . Made by dissolving 6 parts of oil of lemon in 90 parts of alcohol to which 4 parts of freshly-grated lemon peel have been added. This spirit is used in flavoring syrup of citric acid (see page 281).
Spirit of Lemon.

OLEUM BERGAMII. *U.S.* **Oil of Bergamot.**

A volatile oil extracted by mechanical means from the rind of the fresh fruit of *Citrus Bergamia*, var. *vulgaris* Risso et Poiteau (Nat. Ord. *Aurantiaceæ*).

This is an important volatile oil commercially, although it is not used medicinally. It derives its name from Bergamo, a city of Italy, and is largely produced in that country. It is a terpene ($C_{10}H_{16}$). Sp. gr. from 0.860 to 0.890. It is soluble in all proportions in alcohol and glacial acetic acid. This oil is usually prepared by expression in the same manner as the oils of lemon and orange peel. The *ecuelle* (Fig. 335) is a convenient instrument for rapidly rupturing the oil-vesicles: it is held in one hand by the operator, whilst with the other hand the bergamot, lemon, or orange fruit is skilfully rotated on the sharp points: the oil flows into the gutter in the cup, and then through the hollow handle into a suitable vessel. Oil of bergamot is used solely for its perfume.

FIG. 335.

Ecuelle.

Officinal Products from the Labiatæ.

The natural order of the mints is a strongly-marked group, the members of it being remarkable for their botanical analogy with one another and for the similarity of their chemical constituents.

MENTHA PIPERITA. *U.S.* **Peppermint.**

The leaves and tops of *Mentha piperita* Linné (Nat. Ord. *Labiatæ*).

Its properties are due to the presence of about two per cent. of volatile oil. It is largely cultivated, and is a grateful aromatic stimulant.

OLEUM MENTHÆ PIPERITÆ. *U.S.* **Oil of Peppermint.**

A volatile oil distilled from Peppermint.

It is a colorless or yellowish liquid, having the characteristic, strong odor of peppermint, a strongly aromatic taste, followed by a sensation of

cold when air is drawn into the mouth, and a neutral reaction. Sp. gr. about 0.900. It is soluble in an equal weight of alcohol.

The oil of peppermint owes its odor to *menthol* ($C_{10}H_{20}O$), a stearopten obtained from it through fractional distillation, cooling, and crystallization. The crystals are beautiful, colorless needles, melting at 42° C. (76° F.), boiling at 212° C. (414° F.), insoluble in water, but soluble in alcohol, ether, chloroform, and benzin. It is largely used, compressed into cones, as a remedy in neuralgia and headache. A portion of the oil has the composition $C_{10}H_{18}O$.

Officinal Preparations.

Aqua Menthæ Piperitæ (Peppermint Water). . . Made by adding 2 parts of oil of peppermint to 4 parts of cotton, and percolating with distilled water until 1000 parts have been obtained (see page 251).

Spiritus Menthæ Piperitæ (Spirit of Peppermint). Made by dissolving 10 parts of oil of peppermint in 90 parts of alcohol in which 1 part of peppermint has been macerated (see page 282). Dose, twenty minims.

Trochisci Menthæ Piperitæ (Troches of Peppermint). Each troche contains .15 grain of oil of peppermint (see Part V.).

MENTHA VIRIDIS. *U.S.* Spearmint.

The leaves and tops of *Mentha viridis* Linné (Nat. Ord. *Labiatæ*).

The volatile oil is the only constituent of importance in this plant: the yield is from ½ to 1 per cent.

OLEUM MENTHÆ VIRIDIS. *U.S.* Oil of Spearmint.

A volatile oil distilled from Spearmint.

It is a colorless or yellowish liquid, having the characteristic, strong odor of spearmint, a hot, aromatic taste, and a neutral reaction. Sp. gr. about 0.900. It is soluble in an equal weight of alcohol.

Oil of spearmint contains an oxygenated oil, $C_{10}H_{14}O$, which is the odorous portion, and a terpene, $C_{10}H_{16}$. It is used as a stimulant and carminative.

Officinal Preparations.

Aqua Menthæ Viridis (Spearmint Water). . . Made by adding 2 parts of oil of spearmint to 4 parts of cotton, and percolating with distilled water until 1000 parts have been obtained (see page 251).

Spiritus Menthæ Viridis (Spirit of Spearmint). Made by dissolving 10 parts of oil of spearmint in 90 parts of alcohol in which 1 part of spearmint has been macerated (see page 282). Dose, twenty minims.

LAVANDULA. *U.S.* Lavender.

The flowers of *Lavandula vera* De Candolle (Nat. Ord. *Labiatæ*).

This plant is found growing wild in many parts of Europe and the United States; it is largely cultivated here, and in England and France, for the sake of the volatile oil, which is the important constituent.

OLEUM LAVANDULÆ. *U.S.* Oil of Lavender.

A volatile oil distilled from the flowering tops or the whole herb of *Lavandula vera* De Candolle (Nat. Ord. *Labiatæ*).

It is a colorless or yellowish liquid, having the aromatic odor of lavender, a pungent and bitterish taste, and a neutral reaction while fresh. Sp. gr. about 0.890. It is readily soluble in alcohol, and in acetic acid of 90 per cent. or over.

This is an oxygenated oil, containing $C_{10}H_{16}$, and compound ethers of $C_{10}H_{16}O$ and $C_{10}H_{18}O$.

Officinal Preparation.

Tinctura Lavandulæ Composita . . Compound Tincture of Lavender.	Made by dissolving 8 parts of oil of lavender and 2 parts of oil of rosemary in 680 parts of alcohol and 270 parts of water, percolating 4 parts of cloves, 10 parts of nutmeg, and 8 parts of red saunders with the liquid, and adding sufficient diluted alcohol to obtain 1000 parts (see page 315). Dose, one to two fluidrachms.

OLEUM LAVANDULÆ FLORUM. *U.S.* Oil of Lavender Flowers.

A volatile oil distilled from fresh Lavender.

It is a colorless or yellowish liquid, having the fragrant odor of lavender flowers, a pungent and bitterish taste, and a neutral reaction while fresh. Sp. gr. about 0.890. It is readily soluble in alcohol and in acetic acid of 90 per cent. or over.

When heated to about 80° C. (176° F.), it should not yield a colorless distillate having the characteristics of alcohol.

Oil of lavender flowers is most largely used in perfumery. The best quality is distilled at Mitcham, England. It has the same composition and properties as oil of lavender: it is more fragrant and more expensive.

Officinal Preparation.

Spiritus Lavandulæ . Spirit of Lavender.	Made by dissolving 3 parts of oil of lavender flowers in 97 parts of alcohol (see page 281). Dose, one fluidrachm.

ROSMARINUS. *U.S.* Rosemary.

The leaves of *Rosmarinus officinalis* Linné (Nat. Ord. *Labiatæ*).

This plant is valuable solely on account of the fragrant volatile oil which it contains.

OLEUM ROSMARINI. *U.S.* Oil of Rosemary.

A volatile oil distilled from Rosemary.

It is a colorless or yellowish liquid, having the characteristic, pungent odor of rosemary, a warm, somewhat camphoraceous taste, and a neutral or faintly acid reaction. Sp. gr. about 0.900. It is readily soluble in alcohol.

This oil consists of a terpene, $C_{10}H_{16}$, and the oxygenated compounds $C_{10}H_{16}O$, $C_{10}H_{18}O$. It is used as an ingredient in soap liniment, cologne, and compound tincture of lavender.

HEDEOMA. *U.S.* Hedeoma. [PENNYROYAL.]

The leaves and tops of *Hedeoma pulegioides* Persoon (Nat. Ord. *Labiatæ*).

This indigenous plant is frequently confounded with Mentha pulegium, or European pennyroyal, which yields an oil having a similar odor and properties. It is stimulant and aromatic.

OLEUM HEDEOMÆ. *U.S.* Oil of Hedeoma. [OIL OF PENNYROYAL.]

A volatile oil distilled from Hedeoma.

It is a colorless or yellowish liquid, of a pungent, mint-like odor and taste, and a neutral reaction. Sp. gr. about 0.940. It is readily soluble in alcohol.

This is an oxygenated oil, and is used principally to protect the exposed parts of the body from the bites of flies, mosquitoes, fleas, etc. It is employed sometimes in amenorrhœa, in doses of one or two minims.

MARRUBIUM. *U. S.* **Marrubium.** [HOREHOUND.]

The leaves and tops of *Marrubium vulgare* Linné (Nat. Ord. *Labiatæ*).

This plant contains a volatile oil associated with resin and a bitter principle, *marrubiin*. It is stimulant, tonic, and expectorant.

MELISSA. *U. S.* **Melissa.** [BALM.]

The leaves and tops of *Melissa officinalis* Linné (Nat. Ord. *Labiatæ*).

This plant owes its properties of a stimulant and carminative to an oxygenated volatile oil.

ORIGANUM. *U. S.* **Origanum.** [WILD MARJORAM.]

Origanum vulgare Linné (Nat. Ord. *Labiatæ*).

This herb contains an oxygenated volatile oil in very small quantity. *This is not the plant which yields commercial oil of origanum.* (See Oleum Thymi.)

OLEUM THYMI. *U. S.* **Oil of Thyme.**

A volatile oil distilled from *Thymus vulgaris* Linné (Nat. Ord. *Labiatæ*).

It is a colorless or pale yellow, thin liquid, having a strong odor of thyme, a warm, pungent, and afterwards cooling taste, and a neutral reaction. Sp. gr. about 0.880. It is readily soluble in alcohol.

The oil, as prepared in the south of France, is known commercially as *oil of origanum*. It is, after one distillation, of a reddish-brown color, and is called the *red oil*, but when again distilled is colorless, and in this condition is distinguished as the *white oil*. The sp. gr. of the red or common oil is stated at 0.905, but probably varies, as the oil is a complex body. The more volatile portion, that coming over below 180° C. (356° F.) in distillation, is a mixture of *cymene*, $C_{10}H_{14}$, boiling at 175° C. (347° F.), and *thymene*, $C_{10}H_{16}$, boiling at 165° C. (329° F.). The less volatile portion is chiefly *thymol*, $C_{10}H_{14}O$, a white, crystalline solid, melting at 44° C. (111.2° F.), and possessing a pungent taste. This substance is also found in oil of monarda (horsemint). (See Thymol.)

Uses.—Oil of origanum, as it is usually called, is largely used in liniments as a stimulant.

SALVIA. *U. S.* **Salvia.** [SAGE.]

The leaves of *Salvia officinalis* Linné (Nat. Ord. *Labiatæ*).

This useful plant contains a volatile oil, which consists of a terpene, $C_{10}H_{16}$, and an oxygenated portion, *salviol*, $C_{10}H_{18}O$. It also contains tannin and extractive. It is used largely as a condiment. Infusion of sage is a popular remedy in sore throat.

SCUTELLARIA. *U.S.* Scutellaria. [SCULLCAP.]

Scutellaria lateriflora Linné (Nat. Ord. *Labiatæ*).

This plant contains volatile oil, tannin, and a bitter principle. It is used as a tonic and antispasmodic.

Officinal Preparation.

Extractum Scutellariæ Fluidum Fluid Extract of Scutellaria. — Made with a menstruum of 1 part of alcohol and 2 parts of water by percolation (see page 360). Dose, one half to one fluidrachm.

Unofficinal Plants of the Labiatæ containing Volatile Oil.

Collinsonia. Horsebalm.	The herb of *Collinsonia canadensis*, grown in North America.
Glechoma. Ground-Ivy.	From *G. hederacea* and others, grown in Europe. It contains volatile oil, resin, etc.
Hyssopus. Hyssop.	From *H. officinalis*, indigenous to Southern Europe. It contains about ½ per cent. of volatile oil, etc.
Oil of Hyssop.	From Hyssop. A pale yellow or greenish, limpid, oxygenated oil, of sp. gr. .94.
Leonurus. Motherwort.	The herb of *L. cardiaca*, grown in Europe. It contains volatile oil and a bitter principle.
Lycopus. Bugleweed.	The herb of *L. virginicus*, found in the United States. It contains a volatile oil, resin, etc.
Monarda. Horsemint.	The leaves and tops of *M. punctata*, indigenous to the United States. It contains a volatile oil, etc.
Oil of Horsemint.	A yellow, yellowish-red, oxygenated oil, of peculiar odor and pungent taste.
Oil of Origanum, $(C_{10}H_{16})_5O$.	From *Origanum vulgare*. A pale yellow, limpid oil, pungent and slightly bitter taste. Sp. gr. .87–.91. It is colored blood-red with sulphuric acid.

Officinal Products of the Aromatic Umbelliferæ.

The aromatic plants belonging to the natural order Umbelliferæ are all characterized by the very distinctive properties of the volatile oils obtained by distilling their fruits (sometimes called seeds) with water. These oils are oxygenated, and are soluble in alcohol. Cumin and dill belong to this class: they are not officinal.

CARUM. *U.S.* Caraway.

The fruit of *Carum Carvi* Linné (Nat. Ord. *Umbelliferæ*, *Orthospermæ*).

This fruit, commonly called caraway seed, contains about 5 per cent. of volatile oil, with a little fixed oil and other constituents. It is carminative and stimulant.

OLEUM CARI. *U.S.* Oil of Caraway.

A volatile oil distilled from Caraway.

It is a pale yellow liquid, having the odor of caraway, and a sp. gr. of about 0.920. It is soluble in an equal weight of alcohol. It consists of a terpene, *carvene*, $C_{10}H_{16}$, and *carvol*, $C_{10}H_{14}$. It is a useful aromatic oil.

FŒNICULUM. *U.S.* Fennel.

The fruit of *Fœniculum vulgare* Gaertner (Nat. Ord. *Umbelliferæ*, *Orthospermæ*).

This fruit contains about 5 per cent. of an oxygenated volatile oil, with 10 per cent. of fixed oil. It is used in compound infusion of senna and in compound powder of glycyrrhiza.

OLEUM FŒNICULI. Oil of Fennel.

A volatile oil distilled from Fennel.

This is a pale yellow liquid, having the odor of fennel, and a sp. gr. of not less than 0.960. It sometimes congeals when cooled to 5° C. (41° F.). It consists of a terpene, $C_{10}H_{16}$, and anethol, $C_{10}H_{12}O$.

Officinal Preparation.

Aqua Fœniculi . Made by adding 2 parts of oil of fennel to 4 parts of cotton and percolating
Fennel Water. it with 1000 parts of distilled water (see page 251).

Unofficinal Plants of the Umbelliferæ containing Volatile Oil.

Anethum Graveolens. Dill.	An umbelliferous fruit, indigenous to Southern Europe.
Oleum Anethi. Oil of Dill.	An oxygenated oil: the yield is about 4 per cent.
Angelica. Angelica-root.	The root of several species of *Angelica*, grown in Europe and America.
Oleum Angelicæ. Oil of Angelica.	A yellowish, volatile oil: the yield is about ½ per cent.
Carota. Carrot Fruit.	The fruit of *Daucus Carota*, indigenous to Northern Asia.
Oil of Carrot.	An oxygenated oil.
Cicuta. Water-Hemlock.	The herb of *Cicuta virosa*, found in Northern Canada.
Cuminum. Cumin.	The fruit of *Cuminum Cyminum*, indigenous to Egypt.
Oil of Cumin.	Consists of several hydrocarbons: the yield is about ½ per cent.
Heracleum. Cow-Parsnip (Masterwort).	From *Heracleum lanatum*, grown in the United States. It contains a volatile oil, resin, etc.
Levisticum. Lovage.	The root of *Levisticum officinale*, indigenous to Southern Europe. It contains soft and pungent resins.
Petroselinum. Parsley.	The root of *P. sativum*, indigenous to Europe. It contains a volatile oil and apiin, $C_{24}H_{28}O_{12}$.
Oil of Parsley.	A colorless or yellowish, volatile oil, sp. gr. 1.01–1.14: the yield is about 1½ per cent.
Phellandrium. Water-Fennel.	The fruit of *Œnanthe Phellandrium*, grown in Europe. It contains about 1½ per cent. of volatile oil and resins.

CORIANDRUM. *U.S.* Coriander.

The fruit of *Coriandrum sativum* Linné (Nat. Ord. *Umbelliferæ*, *Cœlospermæ*).

This fruit furnishes an agreeable aromatic oil. The yield is about 1 per cent. It also contains about 10 per cent. of fixed oil. It enters into confection of senna.

OLEUM CORIANDRI. *U.S.* Oil of Coriander.

A volatile oil distilled from Coriander.

It is a colorless or yellowish liquid, having the characteristic aromatic odor of coriander, a warm, spicy taste, and a neutral reaction. Sp. gr. about 0.870. It is readily soluble in alcohol.

This oil is composed principally of $C_{10}H_{18}O$. It is officinally used in syrup of senna.

SUMBUL. *U.S.* Sumbul.

The root of *Ferula Sumbul* Hooker filius (Nat. Ord. *Umbelliferæ*, *Orthospermæ*).

This Asiatic root contains about ½ per cent. of volatile oil and about 10 per cent. of a resinous compound having a musky odor. It is used as a stimulant and nervine.

Officinal Preparation.

Tinctura Sumbul . . . Made by percolating 10 parts of sumbul with alcohol until 100 parts are obtained (see page 320). Dose, one-half to one fluidrachm.
Tincture of Sumbul.

ANISUM. *U. S.* Anise.

The fruit of *Pimpinella Anisum* Linné (Nat. Ord. *Umbelliferæ, Orthospermæ*).

This fruit contains about 2 per cent. of volatile oil and 3 per cent. of fixed oil. It is a useful carminative and stimulant.

OLEUM ANISI. *U. S.* Oil of Anise.

A volatile oil distilled from Anise, or from Illicium.

This oil is colorless or yellowish, with the peculiar odor and taste of the fruit. Its sp. gr. is about 0.976 to 0.990, increasing with age. At 10° to 15° C. (50° to 59° F.) it solidifies to a crystalline mass, which does not resume its fluidity until the temperature rises to about 17° C. (62.6° F.). The oil is soluble in an equal weight of alcohol. *Oil of Illicium* (*Star-Anise*) has nearly the same properties, except that it congeals at about 2° C. (35.6° F.). It consists of a small quantity of a hydrocarbon, $C_{10}H_{16}$, but mainly of *anethol*, $C_{10}H_{12}O$, which is present in two modifications, one solid at ordinary temperatures and heavier than water (*anise camphor, solid anethol*), the other liquid and more volatile (*liquid anethol*). *Anethol*, both in the liquid and in the solid form, is present, and is the chief constituent of the oils of *anise, star-aniseed*, and *fennel*.

Officinal Preparations.

Aqua Anisi . . . . . Made by adding 2 parts of oil of anise to 4 parts of cotton and percolating with distilled water until 1000 parts are obtained (see page 249).
Anise Water.

Spiritus Anisi . . . . . Made by mixing 10 parts of oil of anise with 90 parts of alcohol (see page 280). Dose, thirty minims to one fluidrachm.
Spirit of Anise.

ILLICIUM. *U. S.* Illicium. [STAR-ANISE.]

The fruit of *Illicium anisatum* Loureiro (Nat. Ord. *Magnoliaceæ*).

This fruit does not belong to the Umbelliferæ, but, as it is the source of nearly all the commercial oil of anise, it must be considered here. Star-anise contains about 5 per cent. of volatile oil, identical with the oil from Pimpinella Anisum (see Oleum Anisi): it also contains resin and fixed oil.

Officinal Aromatic Products, with their Volatile Oils.

CINNAMOMUM. *U. S.* Cinnamon.

The inner bark of the shoots of *Cinnamomum zeylanicum* Breyne (Ceylon Cinnamon), or the bark of the shoots of one or more undetermined species of *Cinnamomum* grown in China (Chinese Cinnamon) (Nat. Ord. *Lauraceæ*).

Both Ceylon cinnamon and Chinese cinnamon, or *cassia*, owe their virtues to a volatile oil: there are also present tannin, mannit, mucilage, sugar, etc. The tannin present often causes fluid extract of cinnamon to gelatinize through its alteration. Nine officinal preparations contain cinnamon; in one it is the sole active ingredient.

Officinal Preparation.

Tinctura Cinnamomi . . Made by percolating 10 parts of powdered cinnamon with sufficient menstruum, composed of 3 parts of alcohol and 2 parts of water, to obtain 100 parts (see page 309). Dose, one to two fluidrachms.
Tincture of Cinnamon.

OLEUM CINNAMOMI. *U.S.* Oil of Cinnamon.

A volatile oil distilled from Cinnamon.

There are two oils of cinnamon in commerce: one procured from the Ceylon cinnamon, the other from the Chinese cinnamon, the latter distinguished by the name of *oil of cassia.* There is no essential difference in the two oils; and that of the Chinese cinnamon, as much the cheaper and more abundant of the two, will probably continue to be generally employed, notwithstanding that the Ceylon product has the finer flavor.

Oil of Ceylon Cinnamon has a slightly acid reaction. Sp. gr. about 1.040. It is readily soluble in alcohol. When cooled to —10° C. (14° F.) it remains clear, but at a lower temperature a solid portion separates from it. *Oil of Chinese Cinnamon* (Oil of Cassia) has the same properties, except that its sp. gr. is about 1.060 and its odor and taste are not quite so agreeable.

With the exception of quite small quantities of hydrocarbons, oil of cinnamon consists of *cinnamic aldehyd*, C_9H_8O, which, by moderate oxidation, yields the corresponding cinnamic acid, $C_9H_8O_2$, but by more energetic oxidation yields benzoic acid, $C_7H_6O_2$.

Oil of Ceylon cinnamon which is not very fresh contains cinnamic acid in sufficient quantity to give a permanent cloudiness to cinnamon water made from it.

Officinal Preparations.

Aqua Cinnamomi . . Made by adding 2 parts of oil of cinnamon to 4 parts of cotton, and percolating with distilled water until 1000 parts are obtained (see page 250).
Cinnamon Water.

Spiritus Cinnamomi . Made by mixing 10 parts of oil of cinnamon with 90 parts of alcohol (see page 281). Dose, ten to twenty minims.
Spirit of Cinnamon.

CARYOPHYLLUS. *U.S.* Cloves.

The unexpanded flowers of *Eugenia caryophyllata* Thunberg (Nat. Ord. *Myrtaceæ*).

Cloves contain about 16 per cent. of volatile oil, 10 per cent. of tannin, *caryophyllin*, $C_{10}H_{16}O$, a crystalline principle, and *eugenin*, $C_{10}H_{12}O_2$, also crystalline. It is used as an aromatic in three officinal preparations.

OLEUM CARYOPHYLLI. *U.S.* Oil of Cloves.

A volatile oil distilled from Cloves.

Oil of cloves, when recently distilled, is very fluid, clear, and colorless, but becomes yellowish by exposure, and ultimately reddish brown. It has the odor of cloves, a hot, acrid, aromatic taste, and a slightly acid reaction. Its sp. gr. is about 1.050. It is very soluble in alcohol. With an equal volume of a concentrated solution of potassa it forms a semi-solid mass (potassium eugenate). It is completely soluble in ether and glacial acetic acid. The oil of cloves consists of two distinct oils, one lighter (a terpene) and the other heavier than water. They may be separated by distilling the oil from a solution of potassa. The lighter comes over, the heavier remains combined with the potassa, from which it may be separated by adding sulphuric acid and again distilling. *Light oil of cloves* is colorless, is of the sp. gr. 0.918, and has the formula

$C_{10}H_{16}$. It is said not to possess active properties. *Heavy oil of cloves* is colorless at first, but darkens with age, has the odor and taste of cloves, is of the sp. gr. 1.079, boils at 243.3° C. (470° F.), and forms soluble and crystallizable salts with the alkalies. It consists of a phenol-like compound, *eugenol* (eugenic acid), $C_{10}H_{12}O_2$, which has been found capable of conversion into *vanillin*.

Oil of cloves is largely used as a remedy for toothache. It produces relief if the pain is caused by an exposed nerve, and may be used by applying a little upon cotton to the affected nerve.

PIMENTA. *U.S.* Pimenta. [ALLSPICE.]

The nearly ripe fruit of *Eugenia Pimenta* De Candolle (Nat. Ord. *Myrtaceæ*).

This aromatic fruit contains about 3 per cent. of volatile oil, with tannin, fat, resin, gum, sugar, etc.

OLEUM PIMENTÆ. *U.S.* Oil of Pimenta. [OIL OF ALLSPICE.]

A volatile oil distilled from Pimenta.

It is a colorless or pale yellow liquid, becoming darker and thicker by age and exposure to air, having a strong, aromatic, clove-like odor, a pungent, spicy taste, and a slightly acid reaction. Sp. gr. about 1.040. It is readily soluble in alcohol. With an equal volume of a concentrated solution of potassa it forms a semi-solid mass.

It contains a terpene, $C_{10}H_{16}$, and eugenol, $C_{10}H_{12}O_2$. It is used as an ingredient in aromatic spirit of ammonia and spirit of myrcia.

OLEUM MYRCIÆ. *U.S.* Oil of Myrcia. [OIL OF BAY.]

A volatile oil distilled from the leaves of *Myrcia acris* De Candolle (Nat. Ord. *Myrtaceæ*).

It is a brownish or dark brown liquid, of an aromatic, somewhat clove-like odor, a pungent, spicy taste, and a slightly acid reaction. Sp. gr. about 1.040. Soluble in an equal weight of alcohol. With an equal volume of a concentrated solution of potassa it forms a semi-solid mass.

This oil, like the oil of cloves and the oil of pimenta, consists of two portions, a terpene, $C_{10}H_{16}$, and eugenol, $C_{10}H_{12}O_2$.

Officinal Preparation.

Spiritus Myrciæ . . . . . Spirit of Myrcia (Bay Rum). .	Made by mixing 16 parts of oil of myrcia, 1 part of oil of pimenta, and one part of oil of orange peel, with alcohol and water to make 1800 parts (see page 282). Used externally.

VANILLA. *U.S.* Vanilla.

The fruit of *Vanilla planifolia* Andrews (Nat. Ord. *Orchidaceæ*).

This valuable drug contains a trace of a volatile oil, 10 per cent. of fixed oil, resin, sugar, etc., and *vanillin*, $C_8H_8O_3$. This is the aldehyd of methyl-protocatechuic acid, and is now largely prepared from eugenol, coniferin, phenol, and benzoin.

Artificial vanillin has been used as a substitute for vanilla in flavoring; but, owing to the presence of the odorous oil in "vanilla bean," it is not identical.

Officinal Preparation.

Tinctura Vanillæ . . . Tincture of Vanilla. Made by macerating 10 parts of vanilla with 50 parts of a mixture of 2 parts of alcohol and 1 part of water, draining and reserving the macerate, beating the residue with 20 parts of sugar, and percolating with the reserved liquid and sufficient menstruum to make 100 parts (see page 321).

OLEUM CAJUPUTI. *U.S.* Oil of Cajuput.

A volatile oil distilled from the leaves of *Melaleuca Cajuputi* Roxburgh (Nat. Ord. *Myrtaceæ*).

This aromatic oil is very fluid, transparent, of a green color, a penetrating odor analogous to that of cardamom, and a warm, pungent taste. Its composition is $C_{10}H_{16}.H_2O$. It is termed chemically *cajuputene hydrate*, or *cajuputol*. It boils at 175° C. (347° F.), and is freely soluble in alcohol. Sp. gr. about 0.920. On shaking 5 C.c. of the Oil with 5 C.c. of water containing a drop of diluted hydrochloric acid, the Oil loses its green tint and becomes nearly colorless. When it is distilled, a light, colorless liquid first comes over, and afterwards a green and denser one. The green color has been ascribed to a salt of copper derived from the vessels in which the distillation is performed; and various investigators have found traces of copper present in it. Others, again, have carefully tested the green oil and proved its absence. A fair inference is that the oil of cajuput is naturally green, but that as found in commerce it sometimes contains copper, either accidentally present, or added with a view of imitating or maintaining the fine color of the oil.

EUCALYPTUS. *U.S.* Eucalyptus.

The leaves of *Eucalyptus globulus* Labillardière (Nat. Ord. *Myrtaceæ*), collected from rather old trees.

The virtues of eucalyptus leaves depend upon a volatile oil: there are also present resin, tannin, chlorophyl, fatty acid, etc. The leaves are used as a stimulant, febrifuge, or astringent.

Officinal Preparation.

Extractum Eucalypti Fluidum . Fluid Extract of Eucalyptus. Made by percolating Eucalyptus with alcohol (see page 345). Dose, ten to forty minims.

OLEUM EUCALYPTI. *U.S.* Oil of Eucalyptus.

A volatile oil distilled from the fresh leaves of *Eucalyptus globulus* or *Eucalyptus amygdalina* Labillardière, and some other species of *Eucalyptus* (Nat. Ord. *Myrtaceæ*).

It is a colorless or very pale yellowish liquid, having a characteristic aromatic odor, a pungent, spicy, and cooling taste, and a neutral reaction. Sp. gr. about 0.900. It is soluble in an equal weight of alcohol.

The larger portion of the oil consists of *eucalyptol*, $C_{10}H_{16}O$, which is very soluble in alcohol; there are also present two terpenes, $C_{10}H_{14}$, $C_{10}H_{16}$.

MYRISTICA. *U.S.* Nutmeg.

The kernel of the seed of *Myristica fragrans* Houttuyn (Nat. Ord. *Myristicaceæ*), deprived of its testa.

This valuable spice owes its activity to the presence of an oxygenated

volatile oil. Nutmeg contains about 25 per cent. of fixed oil, together with proteids, starch, etc. It forms one of the ingredients in at least seven officinal preparations.

OLEUM MYRISTICÆ. *U.S.* Oil of Nutmeg.

A volatile oil distilled from Nutmeg.

It is a colorless or pale yellowish liquid, having the characteristic odor of nutmeg, a hot, spicy taste, and a neutral reaction. Sp. gr. about 0.930. It is readily soluble in alcohol.

This oil consists of a terpene called myristicene, $C_{10}H_{16}$, and an oxygenated portion, $C_{10}H_{14}O$, myristicol. It was formerly used in aromatic spirit of ammonia.

Expressed oil of nutmeg, or *oil of mace*, is made by expressing nutmegs between hot plates, or macerating them in carbon disulphide, and distilling the macerate. It is a fat, having the composition $C_3H_5(C_{14}H_{27}O_2)_3$, myristicin.

Officinal Preparation.

Spiritus Myristicæ. Made by mixing 3 parts of oil of nutmeg with 97 parts of alcohol (see Spirit of Nutmeg. page 282).

MACIS. *U.S.* Mace.

The arillus of the fruit of *Myristica fragrans* Houttuyn (Nat. Ord. *Myristicaceæ*).

This aromatic contains about 10 per cent. of a light, volatile oil, chiefly a terpene, $C_{10}H_{16}$ (macene). A fixed oil is obtained from mace: it is not a solid, and is not identical with the expressed oil of nutmeg, erroneously called *oil of mace*.

CASCARILLA. *U.S.* Cascarilla.

The bark of *Croton Eluteria* Bennett (Nat. Ord. *Euphorbiaceæ*).

Cascarilla contains about 2 per cent. of an oxygenated volatile oil, a crystalline principle, *cascarillin*, $C_{12}H_{18}O_4$, 15 per cent. of resin, also tannin, gum, pectin, etc. It is used as a stimulant and tonic. Dose, twenty grains.

SASSAFRAS. *U.S.* Sassafras.

The bark of the root of *Sassafras officinalis* Nees (Nat. Ord. *Lauraceæ*).

This well-known bark contains volatile oil, sassafrid, tannin, starch, resin, etc. It is principally used on account of its aromatic oil. It enters into three officinal preparations of sarsaparilla.

OLEUM SASSAFRAS. *U.S.* Oil of Sassafras.

A volatile oil distilled from Sassafras.

It is a colorless or yellowish liquid, becoming darker and somewhat thicker by age and exposure to air, having the characteristic odor of sassafras, a warm, aromatic taste, and a neutral reaction. Sp. gr. about 1.090. It is readily soluble in alcohol. When treated with cold nitric acid, it becomes dark red, and is finally converted into a red resin.

This oil is largely produced in New Jersey and Maryland from the wood and bark of the sassafras: the yield is about 2 per cent. It consists of a terpene, $C_{10}H_{16}$ (safrene), and an oxygenated portion, $C_{10}H_{10}O_2$ (safrol), the latter in the proportion of 90 per cent.

GAULTHERIA. *U.S.* **Gaultheria.** [WINTERGREEN.]

The leaves of *Gaultheria procumbens* Linné (Nat. Ord. *Ericaceæ*).

Gaultheria contains a heavy volatile oil, ericolin, arbutin, urson, tannin, gum, sugar, etc. It is aromatic and astringent. It is used in compound syrup of sarsaparilla.

OLEUM GAULTHERIÆ. *U.S.* **Oil of Gaultheria.** [OIL OF WINTERGREEN.]

A volatile oil distilled from Gaultheria.

This oil consists of a terpene, $C_{10}H_{16}$, termed *gaultherilene*, and methyl salicylate, $CH_3,C_7H_5O_3$. It is the heaviest of all the volatile oils, having the sp. gr. 1.180. When mixed with concentrated solution of soda or potassa it becomes a solid crystalline mass, and the odor of the oil is lost. It is a colorless or yellow or reddish liquid, of a peculiar, strong, and aromatic odor, a sweetish, warm, and aromatic taste, and a slightly acid reaction. It is readily soluble in alcohol. The reddish color is due to a trace of iron.

The adulteration with chloroform or alcohol is shown by heating it to about 80° C. (176° F.), when the oil should not yield a colorless distillate having the characteristics of chloroform or of alcohol; and that of oil of sassafras by mixing 5 drops of the oil with 5 drops of nitric acid, when the mixture should not acquire a deep red color and should not solidify to a dark red, resinous mass.

Officinal Preparation.

Spiritus Gaultheriæ . Made by mixing 3 parts of oil of gaultheria with 97 parts of alcohol
Spirit of Gaultheria (see page 281). Dose, ten to twenty minims.

CALAMUS. *U.S.* **Calamus.** [SWEET FLAG.]

The rhizome of *Acorus Calamus* Linné (Nat. Ord. *Araceæ*).

Calamus contains a volatile oil having the composition of a terpene, $C_{10}H_{16}$, soft resin, a bitter principle, acorin, starch, and mucilage. It is esteemed solely on account of its aromatic properties, which are due to the volatile oil. It is used in wine of rhubarb.

Officinal Preparation.

Extractum Calami Fluidum . Made with a menstruum of alcohol (see page 338). Dose,
Fluid Extract of Calamus one-half to one fluidrachm.

CARDAMOMUM. *U.S.* **Cardamom.**

The fruit of *Elettaria Cardamomum* Maton (Nat. Ord. *Zingiberaceæ*).

This valuable aromatic is imported from India. The seeds contain 5 per cent. of an oxygenated volatile oil, of the sp. gr. 0.943, 10 per cent. of fixed oil, starch, mucilage, etc. Owing to the presence of the fixed oil, they are very difficult to powder alone: hence the practice in compound powders containing cardamom of mixing the other ingredients with it, so that they may absorb the oil. The oil of cardamom is usually made by percolation with ether, and is a mixture of both volatile and fixed oils. Cardamom enters into a number of officinal preparations, in two of which it is the principal ingredient.

Officinal Preparations.

Tinctura Cardamomi . . . . . Made by percolating 15 parts cardamom with sufficient diluted alcohol to make 100 parts (see page 307). Dose, one fluidrachm.
Tincture of Cardamom.

Tinctura Cardamomi Composita . . Made by percolating 20 parts each of cardamom and cinnamon, 10 parts caraway, and 5 parts cochineal with sufficient diluted alcohol to obtain 940 parts, and adding 60 parts glycerin to the percolate (see page 307). Dose, one fluidrachm.
Compound Tincture of Cardamom.

ZINGIBER. *U. S.* Ginger.

The rhizome of *Zingiber officinale* Roscoe (Nat. Ord. *Zingiberaceæ*).

This well-known and largely-used rhizome owes its virtues to about 4 per cent. of volatile oil, having the composition $C_{10}H_{16}$, and therefore a terpene, and a soft, pungent, aromatic resin, which is soluble in alcohol and ether. It is used in a number of officinal preparations, in three of which it is the sole medicinal ingredient.

Officinal Preparations.

Extractum Zingiberis Fluidum . Made with a menstruum of alcohol (see page 365). Dose, ten to thirty minims.
Fluid Extract of Ginger.

Oleoresina Zingiberis . . . . . Made by percolating powdered ginger with stronger ether (see page 368). The yield is 6 to 8 per cent. Dose, one minim.
Oleoresin of Ginger.

Syrupus Zingiberis . . . . . Made from 2 parts fluid extract of ginger, 65 parts sugar, and sufficient water to make 100 parts (see page 268).
Syrup of Ginger.

Tinctura Zingiberis . . . . . Made by percolating 20 parts of powdered ginger with sufficient alcohol to make 100 parts (see page 321). Dose, one fluidrachm.
Tincture of Ginger.

Trochisci Zingiberis . . . . . Each troche contains 2 grains of tincture of ginger (see Trochisci).
Troches of Ginger.

Unofficinal Aromatic Volatile Oils.

Asarum. The rhizome of *Asarum canadense*. Contains a bitter resin.
Wild Ginger.

Oil of Wild Ginger. A yellowish volatile oil. The yield is about 2 per cent.

Canella. The bark of *Canella alba*, grown in the West Indies.
Canella.

Oil of Canella. The yield is about 1 per cent.

Oil of Cascarilla. From *Croton Eluteria*. The yield is about 1½ per cent.

Oil of Cardamom. From the fruit of *Elettaria Cardamomum*. The yield is about 5 per cent.

Thymus. The leaves of *Thymus vulgaris*, grown in Southern Europe. It contains
Garden Thyme. 2½ per cent. of an oxygenated volatile oil, etc.

Unofficinal Terpenes.

Oil of Burgundy Pitch. From *Abies excelsa*. Nat Ord. Coniferæ. Habitat, Europe.

Calamus. From the rhizome of *Acorus Calamus*. Nat. Ord. Araceæ. Habitat, North America. The yield is about 1½ to 2 per cent.

Canada Turpentine. From the oleoresin of *Abies balsamea*. Nat. Ord. Coniferæ.

Cedrat. From *Citrus medica*. Nat Ord. Aurantiaceæ. Used in perfumery.

Elemi. From *Canarium commune*. Nat. Ord. Burseraceæ. Habitat, Philippine Islands. The yield is about 10 per cent.

Gurjun Balsam. From *Dipterocarpus turbinatus*. Nat. Ord. Dipterocarpaceæ. Habitat, India. The yield is about from 40 to 70 per cent.

Hemlock Spruce. From *Abies canadensis*. Nat. Ord. Coniferæ. Habitat, Canada.

Hungarian Turpentine. From *Pinus Pumilio*. Nat. Ord. Coniferæ.

Jaborandi. From the leaflets of *Pilocarpus pennatifolius*. Nat. Ord. Rutaceæ. Habitat, Brazil.

Myrtle. From *Myrtus communis*. Nat. Ord. Myrtaceæ.

Sage. From the leaves of *Salvia officinalis*. Nat. Ord. Labiatæ. The yield is about ¼ per cent.

Strassburg Turpentine. From *Abies pectinata*. Nat. Ord. Coniferæ.

Templin. From the shoots of *Pinus Pumilio*. It is a colorless or yellowish-green oil, of an agreeable, somewhat terebinthinate odor.

Venice Turpentine. From *Larix europæa*. Nat. Ord. Coniferæ.

Unofficinal Oxygenated Oils.

Oil of Absinthium.	From *Artemisia Absinthium*. Nat. Ord. Compositæ.
Angustura.	From the bark of *Galipea Cusparia*. Nat. Ord. Rutaceæ. Habitat, South America. Yield about ½ per cent. Composition, $C_{12}H_{20}O$.
Anthemis.	From the flower-heads of *Anthemis nobilis*. Nat. Ord. Compositæ. Habitat, Europe.
Arnica.	From the root and flowers of *Arnica montana*. Nat. Ord. Compositæ. Habitat, Europe. Yield about ½ to 1 per cent.
Buchu.	From the leaves of *Barosma betulina*, *B. crenulata*, and *B. serratifolia*. Nat. Ord. Rutaceæ. Habitat, Southern Africa. The yield is from ½ to 1½ per cent.
Camphor.	From the preparation of crude camphor. Nat. Ord. Lauraceæ. Habitat, Asia.
Canella.	From the bark of *Canella alba*. Nat. Ord. Canellaceæ. Habitat, Southern United States. The yield is about from ½ to 1 per cent.
Capsicum.	From the fruit of *Capsicum fastigiatum*. Nat. Ord. Solanaceæ. Habitat, Southern and Central America. The yield is very small.
Cardamom.	From the fruit of *Elettaria Cardamomum*. Nat. Ord. Zingiberaceæ. Habitat, Hindostan. The yield is about 4 per cent.
Carrot.	From the fruit of *Daucus Carota*. Nat. Ord. Umbelliferæ. Indigenous to Northern Asia. The yield is very small.
Cascarilla.	From the bark of *Croton Eluteria*. Nat. Ord. Euphorbiaceæ. Indigenous to the Bahama Islands. The yield of oil is about 1½ per cent.
Catnep.	From the leaves and tops of *Nepeta Cataria*. Nat. Ord. Labiatæ. Habitat, Europe. The yield is small.
Celery.	From the fruit of *Apium graveolens*. Nat. Ord. Umbelliferæ. Habitat, Europe.
Citronella.	From the leaves of *Andropogon Nardus*. Habitat, Ceylon. Used in perfumery.
Clove Cinnamon.	From *Persea caryophyllata*.
Curcuma.	From the rhizome of *Curcuma longa*. Nat. Ord. Zingiberaceæ. Habitat, India. The yield is about 1 per cent.
Cyna.	From the flowers of *Artemisia maritima*. Nat. Ord. Compositæ. Habitat, Asia. A pale yellow oil. The yield is about 2 per cent.
Dahlia.	From the tubers of *Dahlia pinnata*.
Elder (European).	From the flowers of *Sambucus nigra*. Nat. Ord. Caprifoliaceæ. Habitat, Europe. The yield is about from ½ to ½ per cent.
Feverfew.	From *Pyrethrum Parthenium*. Nat. Ord. Compositæ. Habitat, Europe.
Galangal.	From the rhizome of *Alpinia officinarum*. Nat. Ord. Zingiberaceæ. Habitat, China. The yield of oil is about ½ per cent.
Ginger.	From the rhizome of *Zingiber officinale*. Nat. Ord. Zingiberaceæ. Habitat, Jamaica. The yield is about from 1 to 2 per cent.
Ginger Grass.	From the flowers of *Andropogon Schœnanthus*.
Golden Rod.	From the leaves of *Solidago odora*.
Heliotrope.	From the flowers of *Heliotropium peruvianum* and *H. grandiflorum*.
Hop.	From the strobiles of *Humulus Lupulus*. Nat. Ord. Urticaceæ. Habitat, North America. The yield is about 0.8 per cent.
Horsemint.	From the leaves and flowers of *Monarda punctata*. Nat. Ord. Labiatæ. Habitat, United States.
Hyssop.	From the herb of *Hyssopus officinalis*. Nat. Ord. Labiatæ. Habitat, Southern Europe. The yield is about from ½ to ½ per cent.
Ihlang-Ihlang.	From *Unona odoratissima*.
Indian Cannabis.	From *Cannabis sativa*. Nat. Ord. Urticaceæ. Habitat, Asia.
Inula.	From the root of *Inula Helenium*. Nat. Ord. Compositæ. Habitat, Europe. The yield is very small.
Jessamine.	From the flowers of *Jasminum grandiflorum* and *J. fragrans*. Nat. Ord. Jasmineæ. The yield is very small. Used in perfumery.
Laurel.	From *Laurus nobilis*. Nat. Ord. Lauraceæ. Habitat, Southern Europe. The yield of oil is about 20 per cent.
Lilac.	From the flowers of *Syringa vulgaris*. Nat. Ord. Oleaceæ. Used in perfumery.
Lily of the Valley.	From the flowers of *Convallaria majalis*. Nat. Ord. Liliaceæ. The yield is very small. Used in perfumery.
Linden.	From the inflorescence of different species of *Tilia*. Nat. Ord. Tiliaceæ. Habitat, Europe and America. The yield is about from $\frac{1}{20}$ to $\frac{1}{10}$ per cent.
Lovage.	From the root of *Levisticum officinale*. Nat. Ord. Umbelliferæ. Habitat, Europe.

Unofficinal Oxygenated Oils.—(*Continued.*)

Oil of Mace.	From the arillus of *Myristica fragrans*. Nat. Ord. Myristicaceæ. Habitat, Moluccas Islands. The yield is about 8 per cent.
Marrubium.	From *Marrubium vulgare*. Nat. Ord. Labiatæ. Habitat, Europe and Asia. The yield is small.
Marsh Tea.	From the leaves of *Ledum palustre*. Nat. Ord. Ericaceæ. Habitat, Europe and Asia. The yield is about from ¾ to 1½ per cent.
Masterwort.	From *Heracleum lanatum*. Nat. Ord. Umbelliferæ. Habitat, United States. The yield is small.
Matico.	From the leaves of *Artanthe elongata*. Nat. Ord. Piperaceæ. Habitat, tropical America. The yield is about 1½ per cent.
Matricaria.	From the flowers of *Matricaria Chamomilla*. Nat. Ord. Compositæ. Habitat, Europe and United States. The yield is about ½ per cent.
Melissa.	From the leaves and tops of *Melissa officinalis*. Nat. Ord. Labiatæ. Habitat, Europe and United States. The yield is about from ½ to ¾ per cent.
Mignonette.	From the flowers of *Reseda odorata*. Nat. Ord. Resedaceæ. Habitat, Southern France. The yield is very small. Used in perfumery.
Mountain Balm.	From the leaves of *Eriodictyon californicum*. Nat. Ord. Hydrophyllaceæ. Habitat, California.
Myrrh.	From the gum-resin of *Balsamodendron Myrrha*. Nat. Ord. Burseraceæ. Habitat, Arabia. The yield is about from 2 to 2½ per cent.
Olibanum.	From *Boswellia Carterii*. Nat. Ord. Burseraceæ. Habitat, Arabia. The yield is about from 4 to 8 per cent.
Parsley.	From the fruit of *Petroselinum sativum*. Nat. Ord. Umbelliferæ. Habitat, Southern Europe. The yield is about 1½ per cent.
Patchouly.	From *Pogostemon Patchouly*. Nat. Ord. Labiatæ. Habitat, East India.
Phellandrium.	From the fruit of *Œnanthe Phellandrium*. Nat. Ord. Umbelliferæ. The yield is about 1½ per cent.
Red Cedar.	From *Juniperus virginiana*. Nat. Ord. Coniferæ. Habitat, Canada and United States.
Rhodium.	From the root of *Convolvulus Scoparius*. Habitat, Canary Islands. The oil of rhodium sold in pharmacy is usually a factitious article, made by mixing 1 part of oil of rose with 20 parts of oil of copaiba. It is used as a lure for rats.
Saffron.	From *Crocus sativa*. Nat. Ord. Iridaceæ. Habitat, Europe. The yield is about 1 per cent.
Serpentaria.	From the rhizome and rootlets of *Aristolochia Serpentaria* and *A. reticulata*. Nat. Ord. Aristolochiaceæ. Habitat, Virginia. The yield is about ½ per cent.
Summer Savory.	From the herb of *Satureia hortensis*. Nat. Ord. Labiatæ.
Sweet Basil.	From *Ocymum Basilicum*. Nat. Ord. Labiatæ. Habitat, Asia and Africa.
Sweet Cicely.	From *Osmorhiza longistylis*. Nat. Ord. Umbelliferæ.
Sweet Marjoram.	From *Origanum marjorana*. Nat. Ord. Labiatæ.
Sweet Violet.	From the flowers of *Viola odorata*. Nat. Ord. Violaceæ.
Tansy.	From the leaves of *Tanacetum vulgare*. Nat. Ord. Compositæ. Habitat, Europe and North America. The yield is about ¼ to ½ per cent.
Tea.	From the leaves of *Thea chinensis*. Nat. Ord. Ternstrœmiaceæ. Habitat, China. The yield is about from ½ to 1 per cent.
Thuja.	From the branches of *Thuja occidentalis*. Nat. Ord. Coniferæ. Habitat, Canada and United States. The yield is about 1 per cent.
Tuberose.	From the flowers of *Polianthes tuberosa*. Nat. Ord. Amaryllidaceæ.
Verbena (Lemon-grass).	From *Andropogon Citratis*. A grass cultivated in Ceylon and Singapore.
Wormwood.	From the herb of *Artemisia Absinthium*. Nat. Ord. Compositæ. Habitat, Europe. The yield is about ½ per cent.
Zedoary.	From the rhizome of *Curcuma Zedoaria*. Nat. Ord. Zingiberaceæ. Habitat, East India Islands.

Stearoptens from Volatile Oils.

CAMPHORA. *U. S.* Camphor.

$C_{10}H_{16}O$; 152.

A stearopten derived from *Cinnamomum Camphora* F. Nees et Ebermaier (Nat. Ord. *Lauraceæ*), and purified by sublimation.

Camphor is sometimes sublimed in powder by conducting the vapor

into a large chamber (see Sublimation, page 140). This powder is often compressed into oblong cakes, forming *compressed camphor.*

It is in white, translucent masses of a tough consistence and crystalline structure, readily pulverizable in the presence of a little alcohol, ether, or chloroform. It has the sp. gr. 0.990–0.995, melts at 175° C. (347° F.), boils at 205° C. (401° F.), sublimes without residue, and burns with a luminous, smoky flame. It has a penetrating odor and a pungent taste, dissolves readily in alcohol, ether, chloroform, disulphide of carbon, benzin, and fixed and volatile oils, and is sparingly soluble in water.

Preparation.—Refined camphor is usually made by subliming in circular cakes the crude granular camphor imported from China and Japan. The vessels in which the camphor is put are of cast iron, circular, from twelve to fifteen inches or more in diameter, and four inches deep, with perpendicular sides, and a ledge at top, on which the cover rests. This consists of sheet-iron, with a hole through the centre about an inch in diameter, over which a small hollow cone of sheet-iron is placed loosely. The crude camphor, mixed with lime,—the object of which is said to be to combine with the moisture present, which would interfere with the due solidification of the camphor vapor,—is placed in the iron vessels described, of which from twenty to fifty are arranged in a long sand-bath. Heat is then applied until the camphor melts, after which the heat is kept as nearly uniform as possible, so that the vaporization may take place regularly, without violent ebullition. The camphor sublimes on the lower surface of the lid in a solid circular cake, care being taken, by the occasional removal of the iron cone and clearing of the opening by means of a knife, to allow the escape of any accidental excess of the vapor: the round hole in the cakes of camphor is thus accounted for.

Uses.—Camphor is a stimulant. It is given in doses of five to ten grains. There are four officinal preparations of camphor, and it is an ingredient in six others,—soap liniment, camphorated tincture of opium, belladonna liniment, compound liniment of mustard, mixture of chloroform, compound powder of morphine.

Officinal Preparations.

Aqua Camphoræ . . . . Camphor Water.	Made by dissolving 8 parts of camphor in 16 parts of alcohol, distributing the solution through cotton, and percolating this with distilled water until 1000 parts have been obtained (see page 249).
Ceratum Camphoræ . . . Camphor Cerate.	Made by mixing 3 parts of camphor liniment, 12 parts of olive oil, and 85 parts of cerate.
Linimentum Camphoræ . Camphor Liniment.	Made by dissolving 20 parts of camphor in 80 parts of cotton-seed oil (see page 287).
Spiritus Camphoræ . . . Spirit of Camphor.	Made by dissolving 10 parts of camphor in 70 parts of alcohol and 20 parts of water (see page 280). Dose, five to forty minims.

CAMPHORA MONOBROMATA. *U. S.* Monobromated Camphor.

$C_{10}H_{15}BrO$; 230.8.

Preparation.—This compound of camphor may be made by Prof. Maisch's process, as follows. Four ounces of bromine are introduced gradually into a retort in which thirteen ounces of camphor have been previously placed. In fifteen or twenty minutes a brisk reaction will commence. When this subsides, eight or nine ounces more of bromine are to be poured in, in four portions, waiting after each ad-

dition until the reaction ceases. The liquid in the retort is now to be heated to about 132° C. (270° F.), then cooled, and sufficient petroleum benzin added to dissolve the crystalline mass. The crystals which are formed on cooling may be purified by recrystallization from benzin or hot alcohol.

Camphora Monobromata. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Colorless, prismatic needles or scales, permanent in the air, and unaffected by light. When heated, Monobromated Camphor slowly volatilizes; at 65° C. (149° F.) it melts, and may be sublimed at a slightly higher temperature. At 274° C. (525° F.) it boils and is completely volatilized with partial decomposition.	Mild, camphoraceous odor; mild, camphoraceous taste; neutral reaction.	Almost insoluble.	Freely soluble.	Freely soluble in ether, chloroform, hot benzin, and fixed oils; slightly soluble in glycerin.

Tests for Identity.

If Monobromated Camphor is boiled with test-solution of nitrate of silver, it is decomposed, and yields bromide of silver amounting to 81.2 per cent. of the weight of Monobromated Camphor taken. It is soluble, without decomposition, in cold, concentrated sulphuric acid, and will again separate unaltered if the solution be poured into water.

Uses.—Monobromated camphor is given as a nervous sedative, in doses of five grains.

THYMOL. *U.S.* Thymol.

$C_{10}H_{13}HO$; 150.

Preparation.—Thymol is obtained from the volatile oils of several plants by fractional distillation, by which terpenes are separated. The portion distilling above 190° C. (374° F.) is collected, agitated with solution of soda to separate more of the terpenes, and cooled; the compound of thymol with soda is then decomposed by hydrochloric acid. Thymol is recrystallized from an alcoholic solution. It has been obtained from *Monarda didyma* Linn., *M. punctata*, *Ammi copticum*, and *Ptychotis ajowan*. The phenol of the oil of *Thymus serpyllum* Linn. closely resembles thymol, but differs from it in not congealing at 10° C. (50° F.), in its solution in diluted alcohol turning green with ferric chloride, and in the potassium salt with its sulpho-acid being amorphous.

Thymol. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Large crystals of the hexagonal system, nearly or quite colorless. It liquefies with camphor. Its sp. gr. as a solid is 1.028; after fusion it is lighter than water. It melts at about 50° C. (122° F.), remaining liquid at lower temperatures, and boils at about 230° C. (446° F.).	Aromatic, thyme-like odor; pungent, aromatic taste, with a very slight caustic effect upon the lips; neutral reaction.	Cold. 1200 parts. Boiling. 900 parts.	Cold. 1 part. Boiling. Freely soluble.	Soluble in ether, chloroform, benzol, benzin, glacial acetic acid, and in fixed and volatile oils.

Test for Identity.	Impurities.	Test for Impurities.
A portion mixed with half its volume of glacial acetic acid, then with an equal or somewhat greater volume of sulphuric acid, and gently heated, gives a bright reddish-violet color.	Carbolic Acid.	Water saturated with Thymol, when treated with a few drops of test-solution of ferric chloride, should not give a blue color.

Uses.—Thymol is a valuable antiseptic, and may be used for the same purposes as carbolic acid.

Officinal Substances containing Nitrogenated and Sulphurated Oils with Allied Products.

AMYGDALA AMARA. *U. S.* Bitter Almond.

The seed of *Amygdalus communis*, var. *amara* Linné (Nat. Ord. *Rosaceæ*, *Amygdaleæ*.

Bitter almond contains *amygdalin*, $C_{20}H_{27}NO_{11}$, a glucoside which splits into benzyl-aldehyd, or oil of bitter almond, hydrocyanic acid, and glucose, under the influence of emulsin, or synaptase, a ferment which becomes active in the presence of water.

$$\underset{\text{Crystallized Amygdalin.}}{C_{20}H_{27}NO_{11}} + \underset{\text{Water.}}{3H_2O} = \underset{\text{Dextroglucose.}}{2(C_6H_{12}O_6)} + \underset{\text{Hydrocyanic Acid.}}{HCN} + \underset{\text{Oil of Bitter Almond.}}{C_7H_6O} + \underset{\text{Water.}}{H_2O}.$$

It also contains about 35 per cent. of fixed oil, mucilage, sugar, etc., with a trace of tannin in the testa. Bitter almond is used in making the volatile oil, and in syrup of almond.

OLEUM AMYGDALÆ AMARÆ. *U. S.* Oil of Bitter Almond.

A volatile oil obtained from Bitter Almond by maceration with water, and subsequent distillation.

Preparation.—As stated above, oil of bitter almond, or benzyl-aldehyd, is produced as the result of the reaction of emulsin on amygdalin in aqueous mixture: it therefore does not pre-exist in the almond, and cannot be obtained from sweet almond, because amygdalin is not present in the latter.

$$\underset{\text{Amygdalin.}}{C_{20}H_{27}NO_{11}} + \underset{\text{Water.}}{2H_2O} = \underset{\text{Benzyl-aldehyd.}}{C_7H_6O} + \underset{\text{Glucose.}}{2C_6H_{12}O_6} + \underset{\text{Hydrocyanic Acid.}}{HCN}.$$

The process is simply to make a mixture of the bitter almond cake (obtained after the fixed oil has been extracted) with water, and distil it by passing a current of steam through it. Artificial benzyl-aldehyd, which is identical with the product obtained from the almond, is now made from toluol, C_7H_8. By the action of chlorine upon the hot toluol, benzyl chloride, $C_6H_5CH_2Cl$, results, and this yields benzyl-aldehyd on distillation with lead nitrate and water in an atmosphere of carbon dioxide. Artificial benzyl-aldehyd is free from hydrocyanic acid, but is liable to retain traces of chlorine compounds. This artificial product must not be confounded with nitrobenzol, or *oil of myrbane*, which is made by reacting on benzol with nitric acid. Nitrobenzol is made in large quantities for perfuming soap: its odor is similar to, but by no means identical with, that of oil of bitter almond.

Uses.—Oil of bitter almond is sedative and poisonous if it contains hydrocyanic acid. The dose is from one-half to one minim. It is used for flavoring.

Oleum Amygdalæ Amaræ. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A colorless or yellowish, thin liquid. Sp. gr. 1.060 to 1.070 (after removal of hydrocyanic acid, 1.043 to 1.049).	Peculiar, aromatic odor; bitter and burning taste; neutral reaction.	300 parts.	Soluble in all proportions.	Soluble in all proportions of ether; also in nitric acid, at the ordinary temperature, without evolution of nitrous vapors.

Impurities.	Tests for Impurities.
Chloroform or Alcohol.	When heated to 80° C. (176° F.), the Oil should yield no distillate having the odor or characteristics of chloroform or of alcohol.
Nitrobenzol.	If 1 part of the Oil be dissolved in 4 parts of alcohol, then 1 part of potassa added, the mixture heated for a few minutes, then evaporated to one-third, and cooled, the resulting liquid should have a brownish-yellow color, and should be soluble in water with but slight turbidity, but without depositing a brownish-yellow sediment.

Officinal Preparation.

Aqua Amygdalæ Amaræ (Bitter Almond Water). Made by dissolving 1 part of oil of bitter almond in 999 parts of distilled water (see page 249). Dose, one to two fluidrachms.

PRUNUS VIRGINIANA. *U.S.* Wild Cherry.

The bark of *Prunus serotina* Ehrhart (*Cerasus serotina* Loiseleur. Nat. Ord. *Rosaceæ*, *Amygdaleæ*), collected in autumn.

This bark contains amygdalin, emulsin, tannin, bitter principle, starch, resin, etc. As with bitter almond, contact with water results in the production of oil of bitter almond and hydrocyanic acid: as both of the latter principles are volatile and active, all the preparations of wild cherry should be made without heat. An insoluble precipitate of altered tannin is often noticed in old fluid extract of wild cherry. Wild cherry bark is sedative and tonic.

Officinal Preparations.

Infusum Pruni Virginianæ (Infusion of Wild Cherry). . . . . Made with 4 parts of wild cherry and sufficient water to make 100 parts (see page 296). Dose, two fluidounces.

Syrupus Pruni Virginianæ (Syrup of Wild Cherry). . . . . Made with 12 parts of wild cherry, 60 parts of sugar, 5 parts of glycerin, and water to make 100 parts (see page 265). Dose, a tablespoonful.

Extractum Pruni Virginianæ Fluidum (Fluid Extract of Wild Cherry). Made with a menstruum of 2 parts of water and 1 part of glycerin mixed with an equal bulk of diluted alcohol; finishing with the latter (see page 355). Dose, one fluidrachm.

ACIDUM HYDROCYANICUM DILUTUM. *U.S.* Diluted Hydrocyanic Acid. [Prussic Acid.]

A liquid composed of 2 per cent. of Absolute Hydrocyanic Acid [HCN; 27] and 98 per cent. of Alcohol and Water.

	By measure.
Ferrocyanide of Potassium, in coarse powder, 20 parts, or	4 oz. av.
Sulphuric Acid, 15 parts, or	1½ fl. oz.
Diluted Alcohol, 60 parts, or	12½ fl. oz.
Water,	
Distilled Water, each, a sufficient quantity.	

Place the Ferrocyanide of Potassium in a tubulated retort, and add to it *forty parts* [or 8 fl. oz.] of water. Connect the neck of the retort (which is to be directed upward), by means of a bent tube, with a well-cooled condenser, the delivery tube of which terminates in a receiver surrounded with ice-cold water, and containing *sixty parts* [or 12½ fl. oz.] of Diluted Alcohol. All the joints of the apparatus, except the neck of the receiver, having been made air-tight, pour into the retort, through the tubulure, the Sulphuric Acid previously diluted with an equal weight [or 3 fl. oz.] of Water. Agitate the retort gently, and then heat it, in a sand-bath, until the contents are in brisk ebullition, and continue the heat regularly until there is but little liquid mixed with the saline mass remaining in the retort. Detach the receiver, and add to its contents so much distilled water as may be required to bring the product to the strength of 2 per cent. of absolute Hydrocyanic Acid if tested by the following **Method of Assay**: 6.75 Gm. of Diluted Hydrocyanic Acid, diluted with 30 C.c. of water, and mixed with enough of an aqueous suspension of magnesia to make the mixture quite opaque, and afterwards with a few drops of solution of chromate of potassium, should require 50 C.c. of the volumetric solution of nitrate of silver, before the red color caused by the latter ceases to disappear on stirring (corresponding to the presence of 2 per cent. of absolute Hydrocyanic Acid).

Diluted Hydrocyanic Acid may be prepared extemporaneously in the following manner:

Cyanide of Silver, 6 parts, or	50½ grains.
Hydrochloric Acid, 5 parts, or	37 minims.
Distilled Water, 55 parts, or	1 fl. oz.

Mix the Hydrochloric Acid with the Distilled Water, add the Cyanide of Silver, and shake the whole together in a glass-stoppered bottle. When the precipitate has subsided, pour off the clear liquid.

$$\underset{\text{Potassium Ferrocyanide.}}{(K_4FeCy_6)_2} + \underset{\text{Sulphuric Acid.}}{(H_2SO_4)_6} = \underset{\text{Potassium Ferrous Ferrocyanide (Everitt's Salt).}}{K_2Fe_2Cy_6} + \underset{\text{Potassium Acid Sulphate.}}{(KHSO_4)_6} + \underset{\text{Hydrocyanic Acid.}}{6HCy.}$$

Diluted Hydrocyanic Acid is a colorless liquid, of a characteristic odor and taste resembling those of bitter almond, and having a slightly acid reaction. On being heated, it is completely volatilized. If to the Acid, rendered alkaline by potassa, a little ferrous sulphate and ferric chloride be added, and the mixture be acidulated with hydrochloric acid, a blue precipitate will make its appearance.

It is a solution of the very poisonous compound HCN in water. *Cyanogen*, CN or Cy, does not exist ready-formed in nature, but compounds of it are found in plants and animal fluids. It is generally the product of chemical reaction, and was the first compound radical discovered. It is more closely related to the halogens in the character of its combinations than any other class of bodies. It unites with hydrogen to form hydrocyanic acid, HCN, and the compounds with metals and bases are termed cyanides. These have been considered in the previous chapters.

Scheele's hydrocyanic acid is a stronger solution, containing about 5 per cent. of anhydrous acid. Its use should be discouraged as unnecessary, tending to create confusion, and dangerous. Diluted hydrocyanic acid frequently becomes decomposed upon keeping, a black insoluble precipitate which contains paracyanogen forming in the bottle. This decomposition may be prevented or lessened by the addition of alcohol or of a small quantity of sulphuric or hydrochloric acid. The use of cork-stoppered vials is said to be an advantage.

Uses.—Diluted hydrocyanic acid is sedative in doses of one to three minims. Potassium cyanide is often prescribed in combination with an acid and syrup, so that hydrocyanic acid may be generated and dissolved.

SINAPIS ALBA. *U. S.* White Mustard.

The seed of *Sinapis alba* Linné (*Brassica alba* Hooker filius et Thompson. Nat. Ord. *Cruciferæ, Siliquosæ*).

White mustard seed contains *sinalbin*, $C_{30}H_{44}N_2O_{16}S_2$, a crystalline glucoside, which, under the influence of a peculiar ferment, *myrosin*, and water, is split into *acrinyl thiocyanate*, C_8H_7NOS, which is a pungent, volatile oil (this is not the officinal oil of mustard), *sinapine sulphate*, $C_{16}H_{23}NO_5H_2SO_4$, and glucose. The seed contains in addition 20 per cent. of fixed oil, mucilage, gum, etc., but no starch. It is used as a stimulant, condiment, and emetic; externally, it is rubefacient.

SINAPIS NIGRA. *U. S.* Black Mustard.

The seed of *Sinapis nigra* Linné (*Brassica nigra* Koch. Nat. Ord. *Cruciferæ, Siliquosæ*).

Black mustard contains potassium myronate ($KC_{10}H_{18}NS_2O_{10}$), *myrosin*, a ferment, 25 per cent. of fixed oil, mucilage, etc. Under the influence of the myrosin and water the potassium myronate is converted into allyl iso-thiocyanate, or volatile oil of mustard. This action takes place at ordinary temperatures, and explains the pungency of aqueous mixtures of ground mustard.

Officinal Preparation.

Charta Sinapis. Mustard Paper. — Made by first depriving the ground black mustard of fixed oil by percolation with ether, drying, mixing with solution of gutta-percha, and spreading on paper. It must be kept excluded from moisture, to prevent the generation of the volatile oil before it is needed.

OLEUM SINAPIS VOLATILE. *U. S.* Volatile Oil of Mustard.

A volatile oil obtained from Black Mustard by maceration with water, and subsequent distillation.

Chemically, this oil is *allyl iso-thiocyanate;* it is also called *sulphocyanide of allyl:* its production has been explained in the preceding article. It is prepared artificially by distilling *allyl sulphate* with *potassium thiocyanate.* It is a colorless or pale yellow liquid, having a very pungent and acrid odor and taste, and a neutral reaction. Sp. gr. 1.017 to 1.021. It boils at 148° C. (298.4° F.), and is freely soluble in alcohol or ether. If one part of the Oil is gradually added to three parts of sulphuric acid (keeping the mixture cool), the odor of mustard disappears, sulphurous

acid vapor is given off, and the mass becomes thick and only slightly darker.

On heating the Oil to 50° C. (122° F.), in a flask connected with a well-cooled condenser, no liquid having the odor and characteristics of disulphide of carbon should pass over.

Volatile oil of mustard is used as a rubefacient.

Officinal Preparation.

Linimentum Sinapis Compositum . 3 parts volatile oil of mustard, 2 parts extract of mezereum, 6 parts camphor, 15 parts castor oil, and sufficient alcohol to make 100 parts (see page 288).
Compound Liniment of Mustard.

ALLIUM. *U. S.* Garlic.

The bulb of *Allium sativum* Linné (Nat. Ord. *Liliaceæ*).

Garlic contains a volatile sulphurated oil known as allyl sulphide, $(C_3H_5)_2S$, mucilage, albumen, etc. The volatile oil is the active principle. It may be obtained artificially by decomposing allyl iodide with an alcoholic solution of potassium sulphide. Garlic is stimulant, expectorant, and vesicant.

Officinal Preparation.

Syrupus Allii . . Made by macerating 15 parts of garlic in 25 parts of diluted acetic acid, expressing, adding additional liquid, expressing, and obtaining in all 40 parts, then dissolving 60 parts of sugar in it by agitation (see page 260). Dose, one fluidrachm.
Syrup of Garlic.

Unofficinal Sulphurated Oils.

Oil of Asafetida.	From the gum-resin of *Ferula Narthex*. Nat. Ord. Umbelliferæ. Habitat, Western Thibet. The yield is about 6 to 9 per cent.
Bitter Candytuft.	*Iberis amara* contains a sulphurated volatile oil.
Common Scurvy Grass.	From the herb of *Cochlearia officinalis*. Nat. Ord. Cruciferæ. Habitat, Europe.
Cress.	The seed of *Lepidium sativum*. Nat. Ord. Cruciferæ. Contains a sulphurated volatile oil.
Garlic.	From the bulb of *Allium sativum*. Nat. Ord. Liliaceæ. Habitat, Europe and Asia. The yield of oil is about $\frac{1}{4}$ per cent.
Hedge Garlic.	*Alliaria officinalis*. Nat. Ord. Cruciferæ. Contains a sulphurated oil.
Horseradish.	From the root of *Cochlearia Armoracia*. Nat. Ord. Cruciferæ. Habitat, Europe. The yield is about $\frac{1}{20}$ per cent.
Radish.	*Raphanus sativa* contains a sulphurated volatile oil.
Sagapenum.	From *Ferula persica*. The yield of volatile oil is small.
Shepherd's Purse.	The seeds of *Capsella bursa-pastoris* contain a sulphurated volatile oil.
Wallflower.	The seed of *Cheiranthus annuus* contains a sulphurated volatile oil.
Wild Mustard.	The seed of *Sisymbrium nasturtium* contains a sulphurated volatile oil.
Wild Radish.	The seed of *Raphanus Raphanistrum* contains a sulphurated volatile oil.

CHAPTER LVI.

OFFICINAL DRUGS AND PRODUCTS CONTAINING VOLATILE OIL WITH SOFT RESIN.

PIPER. *U.S.* Pepper. [BLACK PEPPER.]

The unripe fruit of *Piper nigrum* Linné (Nat. Ord. *Piperaceæ*).

Black pepper contains piperine, a feeble alkaloid, 2 per cent. of volatile oil, a pungent resin, soluble in alcohol, ether, and alkaline solutions.

The volatile oil is a terpene, $C_{10}H_{16}$. Its principal use is as a condiment.

Officinal Preparation.

Oleoresina Piperis . . . Made by percolating pepper with stronger ether and evaporating the ether (see page 368). The yield is about 5 per cent. Dose, one to two minims.
Oleoresin of Pepper.

PIPERINA. *U.S.* Piperine.

$C_{17}H_{19}NO_3$; 285.

A proximate principle of feebly alkaloidal power, prepared from Pepper, and occurring also in other plants of the Nat. Ord. *Piperaceæ*.

Preparation.—Piperine is obtained by treating pepper with alcohol, evaporating the tincture to the consistence of an extract, submitting the extract to the action of an alkaline solution, by which the oleaginous matter is converted into soap, washing the undissolved portion with cold water, separating the liquid by filtration, treating the matter left on the filter with alcohol, and allowing the solution thus obtained to evaporate spontaneously, or by a gentle heat. Crystals of piperine are deposited, and may be purified by alternate solution in alcohol or ether, and crystallization.

Piperine is decomposed by alkalies in alcoholic solution into *piperic acid*, $C_{12}H_{10}O_4$, and *piperidine*, $C_5H_{11}N$.

Piperina. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Colorless or pale yellowish, shining, four-sided prisms, permanent in the air. When heated to about 128° C. (about 264° F.), Piperine melts, yielding a clear, yellowish liquid, which, on cooling, congeals to a resinous mass. When heated on platinum foil, it takes fire and is consumed without residue.	Odorless; almost tasteless when first put in the mouth, but on prolonged contact producing a sharp and biting sensation; neutral reaction.	Almost insoluble.	Cold. 30 parts. Boiling. 1 part.	Slightly soluble in ether.

TESTS FOR IDENTITY.

Concentrated sulphuric acid dissolves Piperine with a dark, blood-red color, which disappears on dilution with water. When treated with cold nitric acid, Piperine turns rapidly greenish yellow, orange, and red, and gradually dissolves with a reddish color. On adding to this solution an excess of solution of potassa, the color is at first pale yellow, but on boiling it deepens to blood-red, while, at the same time, vapors of an alkaline reaction and of a peculiar odor (piperidine) are given off.

Uses.—Piperine has been used as a stimulant and an antiperiodic. Its virtues, however, in this connection depend principally upon its impurities,—*i.e.*, adhering resin and oil. When absolutely pure and colorless it has but little medicinal action.

MATICO. *U.S.* Matico.

The leaves of *Artanthe elongata* Miquel (Nat. Ord. *Piperaceæ*).

Matico leaves contain about 2 per cent. of volatile oil, a pungent resin, a crystalline principle, *artanthic acid*, and tannin. Matico is stimulant and hæmostatic.

Officinal Preparations.

Extractum Matico Fluidum (Fluid Extract of Matico). Made with a menstruum consisting of 3 parts of alcohol and 1 part of water, with 10 per cent. of glycerin (see page 353). Dose, one-half to one fluidrachm.

Tinctura Matico (Tincture of Matico). Made by percolating 10 parts of powdered matico with diluted alcohol to make 100 parts (see page 315). Dose, one fluidrachm.

CUBEBA. *U.S.* Cubeb.

The unripe fruit of *Cubeba officinalis* Miquel (Nat. Ord. *Piperaceæ*).

This useful fruit, or berry as it is commonly called, contains about 10 per cent. of volatile oil, 3 per cent. of resin, cubebin, *cubebic acid*, wax, fat, etc. The virtues of cubeb reside in the cubebic acid, resin, and oil, cubebin when pure being destitute of activity. Cubebic acid, cubebic resin, and cubebin are all colored red by strong sulphuric acid. Cubeb is used as a diuretic, stimulant, and expectorant.

Officinal Preparations.

Extractum Cubebæ Fluidum (Fluid Extract of Cubeb). Made with a menstruum of alcohol (see page 343). Dose, one-half to one fluidrachm.

Oleoresina Cubebæ (Oleoresin of Cubeb). Made by percolating cubeb with stronger ether, distilling off, and evaporating the ether (see page 367). The yield is 18 to 25 per cent. Dose, five to fifteen minims.

Trochisci Cubebæ (Troches of Cubeb). Each troche contains ½ grain of oleoresin of cubeb (see Trochisci, Part V.).

Tinctura Cubebæ (Tincture of Cubeb). Made by percolating 10 parts of cubeb with sufficient diluted alcohol to make 100 parts (see page 310). Dose, one to two fluidrachms.

OLEUM CUBEBÆ. *U.S.* Oil of Cubeb.

A volatile oil distilled from Cubeb.

It is a colorless, or pale greenish, or yellowish liquid, having the characteristic odor of cubeb, a warm, camphoraceous, aromatic taste, and a neutral reaction. Sp. gr. about 0.920. It is soluble in an equal weight of alcohol.

The oil contains a small amount of a hydrocarbon, $C_{10}H_{16}$, boiling at 158°–163° C. (316.4°–325.4° F.), and two oils of the formula $C_{15}H_{24}$, boiling at 262°–265° C. (503.6°–509° F.), one of which unites with

HCl, while the other does not. Upon standing, it sometimes deposits rhomboidal prismatic crystals of a stearopten. The crystals have the formula $C_{30}H_{48} + 2H_2O$, are fusible at 67°–68° C. (152.6°–154.4° F.), and volatilize without change at 148°–150° C. (298.4°–302° F.). Oil of cubeb is an aromatic stimulant and carminative.

CAPSICUM. *U. S.* **Capsicum.** [CAYENNE PEPPER. AFRICAN PEPPER.]
The fruit of *Capsicum fastigiatum* Blume (Nat. Ord. *Solanaceæ*).

The principal constituents of capsicum are capsaicin, $C_9H_{14}O_2$, traces of a volatile alkaloid and a volatile oil, fixed oil, resin, coloring-matter, etc. *Capsaicin* is in colorless crystals, volatile, intensely acrid, and soluble in alcohol, ether, and fixed oils. Capsicum is stimulant and rubefacient.

Officinal Preparations.

Emplastrum Capsici . . . . . Capsicum Plaster.	Made by spreading resin plaster upon muslin, cooling, and applying a thin coating of oleoresin of capsicum.
Extractum Capsici Fluidum . Fluid Extract of Capsicum.	Made with alcohol (see page 339). Dose, one-half to one minim.
Oleoresina Capsici . . . . . Oleoresin of Capsicum.	Made by percolating powdered capsicum with stronger ether, distilling, and evaporating (see page 367). Yield 5 per cent. Dose, one-fourth to one minim.
Tinctura Capsici . . . . . Tincture of Capsicum.	Made by percolating 5 parts of powdered capsicum with a menstruum of 19 parts of alcohol and 1 part of water until 100 parts are obtained (see page 307). Dose, one-half to one fluidrachm.

COPAIBA. *U. S.* **Copaiba.** [BALSAM OF COPAIBA.]
The oleoresin of *Copaifera Langsdorffii* Desfontaines, and of other species of *Copaifera* (Nat. Ord. *Leguminosæ*, *Papilionaceæ*).

Copaiba is mostly imported from Pará, in Brazil, Maracaibo, in Venezuela, and other South American ports. It contains *copaivic acid*, volatile oil, and a bitter principle. Copaivic acid, $C_{20}H_{30}O_2$, the resinous mass left after distilling the oil, forms a series of amorphous salts. (See Massa Copaiba.) It may be obtained pure by exposing a mixture of nine parts of copaiba and two parts of aqueous ammonia (sp. gr. 0.95) to a temperature of 10° C. (50° F.). Copaiba is often adulterated.

Copaiba. *U.S.*	Odor and Taste.	Solubility. Other Solvents.
A transparent or translucent, more or less viscid liquid, of a color varying from pale yellow to brownish yellow. Sp. gr. 0.940 to 0.993.	Peculiar aromatic odor; persistently bitter and acrid taste.	Readily soluble in absolute alcohol.

Test for Identity.	Impurities.	Tests for Impurities.
It is not fluorescent, and when heated to 130° C. (266° F.) does not become gelatinous.	Fixed Oils.	When subjected to heat, it does not evolve the odor of turpentine, and, after distilling off the volatile oil, the residue, when cool, should be hard and friable.
	Admixture of Foreign Volatile Oil.	The essential oil distilled off from the oleoresin, when rectified, should not begin to boil below 200° C. (392° F.).
	Gurjun Balsam.	On adding 1 drop of Copaiba to 19 drops of disulphide of carbon and shaking the mixture with 1 drop of a cold mixture of equal parts of sulphuric and nitric acids, it should not acquire a purplish-red or violet color.

Uses.—Copaiba is stimulant and diuretic, and has a special irritant action upon the mucous membranes of the urinary passages. Dose, from twenty minims to one fluidrachm.

Officinal Preparations.

Massa Copaibæ . . . This is a copaivate of magnesia, and is made by mixing 6 parts of magnesia with 94 parts of copaiba: the solidification takes place better if the magnesia be hydrated. Dose, five to ten grains. (See Part V.)
Mass of Copaiba.

Resina Copaibæ . . The residue left after distilling copaiba (copaivic acid) (see page 396). Dose, five to ten grains.
Resin of Copaiba.

OLEUM COPAIBÆ. *U. S.* Oil of Copaiba.

A volatile oil distilled from Copaiba.

It is a colorless or pale yellowish liquid, having the characteristic odor of copaiba, a pungent, bitterish taste, and a neutral reaction. Sp. gr. about 0.890. It is soluble in an equal weight of alcohol.

This oil is a hydrocarbon, consisting of $C_{10}H_{16}$ and $C_{15}H_{24}$. It is used as a stimulant, and for the same purposes as copaiba. Dose, five to ten minims.

OLEUM SANTALI. *U.S.* Oil of Santal. [Oil of Sandal-Wood.]

A volatile oil distilled from the wood of *Santalum album* Linné (Nat. Ord. *Santalaceæ*).

It is a pale yellowish or yellow liquid, of a peculiar, strongly aromatic odor, a pungent and spicy taste, and a slightly acid reaction. Sp. gr. about 0.945. It is readily soluble in alcohol.

This is an oxygenated oil, consisting of $C_{15}H_{24}O$ and $C_{15}H_{26}O$. It is used as a stimulant to the mucous membranes, especially in the treatment of gonorrhœa. It is generally administered in capsules. Dose, five to fifteen minims.

OLEUM RUTÆ. *U.S.* Oil of Rue.

A volatile oil distilled from *Ruta graveolens* Linné (Nat. Ord. *Rutaceæ*, *Rutæ*).

It is a colorless or greenish-yellow liquid, of a characteristic, aromatic odor, a pungent, bitterish taste, and a neutral reaction. Sp. gr. about 0.880. It is soluble in an equal weight of alcohol.

This oil has been proved to be methyl-nonyl-ketone, $CH_3.CO.C_9H_{19}$. It is the most soluble in water of the officinal volatile oils.

SCOPARIUS. *U.S.* Scoparius. [Broom.]

The tops of *Sarothamnus Scoparius* Koch (Nat. Ord. *Leguminosæ*, *Papilionaceæ*).

Scoparius contains a volatile oil, *sparteine*, $C_{15}H_{26}N_2$ (bitter oil), *scoparin*, $C_{21}H_{22}O_{10}$, fat, tannin, wax, etc. Water or alcohol extracts its virtues. It is diuretic, and in large doses emetic. Dose, two drachms in decoction.

BUCHU. *U.S.* Buchu.

The leaves of *Barosma betulina* Bartling, *Barosma crenulata* Hooker, and *Barosma serratifolia* Willdenow (Nat. Ord. *Rutaceæ*, *Diosmeæ*).

This drug owes its valuable properties to the presence of a volatile oil and resin: it also contains a bitter principle, mucilage, etc. The stearopten *diosphenol* is colored dark green by ferric chloride. Buchu is used as a diuretic and stimulant.

Officinal Preparation.

Extractum Buchu Fluidum (Fluid Extract of Buchu). Made with a menstruum of 2 parts of alcohol and 1 part of water (see page 338). Dose, one fluidrachm.

SERPENTARIA. *U.S.* Serpentaria. [VIRGINIA SNAKEROOT.]

The rhizome and rootlets of *Aristolochia Serpentaria* Linné, and of *Aristolochia reticulata* Nuttall (Nat. Ord. *Aristolochiaceæ*).

This rhizome, when fresh, contains 1 per cent. of volatile oil, a bitter principle, starch, sugar, etc. It yields its virtues to alcohol and diluted alcohol. It is one of the ingredients in compound tincture of cinchona.

Officinal Preparations.

Extractum Serpentariæ Fluidum (Fluid Extract of Serpentaria). Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 361). Dose, twenty to thirty minims.

Tinctura Serpentariæ (Tincture of Serpentaria). Made by percolating 10 parts of powdered serpentaria with sufficient diluted alcohol to make 100 parts (see page 320). Dose, one fluidrachm.

HUMULUS. *U.S.* Hops.

The strobiles of *Humulus Lupulus* Linné (Nat. Ord. *Urticaceæ*, *Cannabineæ*).

Hops owe their sedative virtues to a small quantity of volatile oil; their bitterness is due to the resin and lupulin present.

Officinal Preparation.

Tinctura Humuli (Tincture of Hops). Made by percolating 20 parts of hops with sufficient diluted alcohol to make 100 parts (see page 313). Dose, one fluidrachm.

LUPULINUM. *U.S.* Lupulin. [LUPULINA, Pharm. 1870.]

The glandular powder separated from the strobiles of *Humulus Lupulus* Linné (Nat. Ord. *Urticaceæ*, *Cannabineæ*).

Lupulin contains 10 per cent. of volatile oil, which, on exposure, yields valerianic acid, trimethylamine, a bitter principle (lupamaric acid), $C_{52}H_{50}O_7$, resin, wax, and an alkaline liquid termed *lupuline*. Alcohol and ether are the best solvents.

Officinal Preparations.

Extractum Lupulinæ Fluidum (Fluid Extract of Lupulin). Made with a menstruum of alcohol (see page 353). Dose, ten to fifteen minims.

Oleoresina Lupulini (Oleoresin of Lupulin). Made by percolating lupulin with stronger ether, distilling, and evaporating the ether. The yield is about 50 per cent. (see page 368). Dose, three to ten minims.

CANNABIS INDICA. *U.S.* Indian Cannabis. [INDIAN HEMP.]

The flowering tops of the female plant of *Cannabis sativa* Linné (Nat. Ord. *Urticaceæ*, *Cannabineæ*), grown in the East Indies.

Indian cannabis contains a resinous substance, *cannabinine*, volatile oil, and tetanocannabinine. Alcohol is the best solvent for the active principles. It is used as an anodyne and nervous stimulant.

Officinal Preparations.

Extractum Cannabis Indicæ (Extract of Indian Cannabis). Made by percolating Indian cannabis with alcohol, distilling the alcohol from the percolate, and evaporating to a pilular consistence (see page 379). Dose, one-fourth grain to two grains.

Extractum Cannabis Indicæ Fluidum (Fluid Extract of Indian Cannabis). Made with alcohol (see page 339). Dose, one-half to one minim.

Tinctura Cannabis Indicæ (Tincture of Indian Cannabis). Made by percolating 20 parts of Indian cannabis with sufficient alcohol to make 100 parts (see page 307). Dose, thirty minims.

CANNABIS AMERICANA. *U.S.* American Cannabis.

Cannabis sativa Linné (Nat. Ord. *Urticaceæ*, *Cannabineæ*), grown in the Southern United States and collected while flowering.

American cannabis contains resin and a trace of volatile oil. It is used like Indian cannabis.

VALERIANA. *U.S.* Valerian.

The rhizome and rootlets of *Valeriana officinalis* Linné (Nat. Ord. *Valerianaceæ*).

Valerian contains about 1 per cent. of volatile oil, valerianic acid, resin, starch, tannin, etc.; there are also present some acetic and formic acids. Alcohol and ether are good solvents for the active principles. It is used as a nervine.

Officinal Preparations.

Abstractum Valerianæ . . . . . Abstract of Valerian.	Made by adding an evaporated alcoholic fluid extract to sugar of milk: 1 grain represents 2 grains of valerian (see page 395). Dose, two to ten grains.
Extractum Valerianæ Fluidum . . Fluid Extract of Valerian.	Made with a menstruum of 2 parts of alcohol and 1 part of water (see page 364). Dose, one fluidrachm.
Tinctura Valerianæ . . . . . Tincture of Valerian.	Made by percolating 20 parts of powdered valerian with a mixture of 2 parts of alcohol and 1 part of water until 100 parts of tincture have been obtained (see page 320). Dose, two fluidrachms.
Tinctura Valerianæ Ammoniata . Ammoniated Tincture of Valerian.	Made by percolating 20 parts of powdered valerian with aromatic spirit of ammonia until 100 parts of tincture have been obtained (see page 321). Dose, two fluidrachms.

OLEUM VALERIANÆ. *U.S.* Oil of Valerian.

Oil of valerian is an oxygenated oil, having a slightly acid reaction, and a sp. gr. about 0.950. It is readily soluble in alcohol. It consists of a terpene, $C_{10}H_{16}$, and a liquid compound, $C_{10}H_{18}O$, which by means of chromic acid affords common camphor and formic, acetic, and valerianic acids, which are met with in old valerian root, owing no doubt to the slow oxidation of the compound $C_{10}H_{18}O$. A crystallizable compound of the same composition, probably *borneol*, is also found in the oil.

VIBURNUM. *U.S.* Viburnum. [Black Haw.]

The bark of *Viburnum prunifolium* Linné (Nat. Ord. *Caprifoliaceæ*).

Viburnum contains valerianic acid, a bitter, resinous principle, *viburnin*, tannin, sugar, etc. Alcohol is the best solvent for its active principles. It is used like valerian, as a nervine and tonic; it has also diuretic properties.

Officinal Preparation.

Extractum Viburni Fluidum . . Fluid Extract of Viburnum.	Made with a menstruum of 2 parts of alcohol and 1 part of water (see page 364). Dose, one-half to one fluidrachm.

SAMBUCUS. *U.S.* Sambucus. [Elder.]

The flowers of *Sambucus canadensis* Linné (Nat. Ord. *Caprifoliaceæ*).

Elder flowers contain a little volatile oil and resin, sugar, mucilage, etc. Water and diluted alcohol are capable of extracting all the virtues that they possess.

CHENOPODIUM. *U. S.* **Chenopodium.** [AMERICAN WORMSEED.]

The fruit of *Chenopodium ambrosioides* Linné, var. *anthelminticum* Gray (Nat. Ord. *Chenopodiaceæ*).

Chenopodium contains a volatile oil, a small quantity of resin, and bitter extractive. Alcohol and ether are good solvents for its active principles. It is used as an anthelmintic.

OLEUM CHENOPODII. *U. S.* **Oil of Chenopodium.** [OIL OF AMERICAN WORMSEED.]

A volatile oil distilled from Chenopodium.

It is a thin, colorless or yellowish liquid, of a peculiar aromatic odor, a pungent and bitterish taste, and a neutral reaction. Sp. gr. about 0.920, increasing by age. It is readily soluble in alcohol.

This oil consists of a terpene, $C_{10}H_{16}$, and an oxygenated portion, $C_{10}H_{16}O$. It is used as an anthelmintic. It is best administered as an emulsion, first mixing the oil with twice its volume of olive oil.

JUNIPERUS. *U. S.* **Juniper.**

The fruit of *Juniperus communis* Linné (Nat. Ord. *Coniferæ*).

This fruit owes its stimulant and diuretic properties to volatile oil and resins; there are also present juniperin, wax, mucilage, fat, etc. Alcohol is a good solvent for it. It is used as a diuretic and stimulant.

OLEUM JUNIPERI. *U. S.* **Oil of Juniper.**

A volatile oil distilled from Juniper.

It is a colorless or faintly greenish-yellow liquid, becoming darker and thicker by age and exposure to air; having the characteristic odor of juniper, a warm, aromatic, somewhat terebinthinate and sweetish taste, and a neutral reaction. Sp. gr. about 0.870. It is soluble in about twelve parts of alcohol, forming a turbid liquid.

Oil of juniper (berries) is a terpene, $C_{10}H_{16}$. It has diuretic and stimulant properties.

Officinal Preparations.

Spiritus Juniperi . . . . . Spirit of Juniper.	Made by mixing 3 parts of oil of juniper with 97 parts of alcohol (see page 281). Dose, one to four fluidrachms.
Spiritus Juniperi Compositus . Compound Spirit of Juniper.	Made by mixing 10 parts of oil of juniper and 1 part each of oils of fennel and caraway with 3000 parts of alcohol and sufficient water to make 5000 parts (see page 281). Dose, one to four fluidrachms.

SABINA. *U. S.* **Savine.**

The tops of *Juniperus Sabina* Linné (Nat. Ord. *Coniferæ*).

Savine contains a terpene, $C_{10}H_{16}$, and resin, with a trace of tannin. Alcohol is the best menstruum.

Officinal Preparation.

Extractum Sabinæ Fluidum . Fluid Extract of Savine.	Made with a menstruum of alcohol (see page 358). Dose, three to eight minims. Savine cerate is made by adding 25 parts of this fluid extract to 90 parts of resin cerate, evaporating the alcohol, and stirring until cold.

OLEUM SABINÆ. *U. S.* Oil of Savine.

A volatile oil distilled from Savine.

It is a colorless or yellowish liquid, becoming darker and thicker by age and exposure to air, having a peculiar, terebinthinate odor, a pungent, bitterish, and camphoraceous taste, and a neutral reaction. Sp. gr. about 0.910.

This oil is a terpene, $C_{10}H_{16}$. It is used as a stimulant and emmenagogue. Owing to its having been frequently used to produce abortion, it should not be dispensed except upon the order of a physician. Dose, two to five minims.

THUJA. *U. S.* Thuja. [ARBOR VITÆ.]

The fresh tops of *Thuja occidentalis* Linné (Nat. Ord. *Coniferæ*).

This coniferous plant yields volatile oil, resin, pinipicrin, and *thujin*, $C_{20}H_{22}O_{12}$. It is used as a diuretic and stimulant. Alcohol makes the best menstruum.

Unofficinal Substances containing Volatile Oil and Resin.

Agaricus Albus. White Agaric.	A fungus from *Polyporus officinalis*, which grows on the trunks of old trees.
Alisma. Water Plantain.	From *Alisma Plantago*, indigenous to Europe. Contains an acrid resin.
Oil of Water Plantain.	A pungent oil.
Aralia Racemosa. American Spikenard.	The rhizome of *A. racemosa*, found in North America. It contains volatile oil, resin, etc.
Cunila. Dittany.	From *C. Mariana*, found in the United States. It contains volatile oil and resin.
Galanga. Galangal.	The rhizome of *Alpinia officinarum*, grown in China. It contains ½ per cent. of volatile oil, and a pungent, soft resin, etc.
Oil of Galangal, $C_{10}H_{18}O$.	A pale yellow or brownish-yellow volatile oil.
Iris Florentina. Florentine Orris.	The rhizome of different species of *Iris*, grown in Europe. It contains a volatile oil, soft, acrid resin, etc.
Juniperus Virginiana. Red Cedar.	The tops of *J. virginiana*, grown in Canada and the United States. It contains volatile oil, resin, etc.
Oil of Red Cedar.	Distilled from the wood of *Juniperus virginiana*.
Laserpitium. White Gentian.	From *L. latifolium*, found in Europe. It contains volatile oil and a bitter principle.
Laurocerasus. Cherry Laurel.	From *Prunus Laurocerasus*, found in Western Asia. It contains volatile oil, resin, etc.
Laurus. Laurel.	The leaves and fruit of *L. nobilis*, indigenous to the Levant. It contains volatile and fixed oils, also resin, etc.
Oil of Laurel.	A pale yellow oxygenated oil, sp. gr. 91. The yield is about 2 per cent.
Levisticum. Lovage.	From *L. officinale*, found in Europe. It contains volatile oil, resins, etc.
Liatris. Liatris.	From different species of *Liatris*, indigenous to North America.
Myrica. Bayberry.	The leaves of *M. cerifera*, found near Lake Erie and the Atlantic coast. It contains volatile oil, resin, etc.
Myrtus. Myrtle.	From *M. communis*, found along the Mediterranean. It contains a volatile oil, resin, etc.
Piper Methysticum. Kava-Kava.	The root of *P. Methysticum*, indigenous to the Sandwich Islands. It contains a volatile oil and acrid resin.
Psoralea. Psoralea.	From different species of *Psoralea*, found in the United States. It contains a volatile oil and resin.
Ptelea. Shrubby Trefoil.	From *P. trifoliata*, found in North America. It contains a volatile oil and pungent resin.
Santalum Album. Santal-wood.	The wood of *S. album*. It contains an oxygenated volatile oil and resin. (See Oleum Santali.)
Wintera. Winter's Bark.	The bark of *Drimys Winteri*, grown in South America.
Oil of Winter's Bark.	The yield of volatile oil is about 1½ per cent.

Officinal Drugs and Products containing Volatile Oil associated with Bitter Principle or Extractive.

ABSINTHIUM. *U.S.* Absinthium. [WORMWOOD.]

The leaves and tops of *Artemisia Absinthium* Linné (Nat. Ord. *Compositæ*).

This drug contains 1 per cent. of an oxygenated volatile oil, which is chiefly absinthol, $C_{10}H_{16}O$; the bitter principle is *absinthin*, $C_{40}H_{56}O_9$. It also contains tannin, resin, and succinic acid. It is one of the ingredients in aromatic wine.

TANACETUM. *U.S.* Tansy.

The leaves and tops of *Tanacetum vulgare* Linné (Nat. Ord. *Compositæ*).

Tansy contains a small quantity of volatile oil, which is freely soluble in alcohol; the bitter principle is *tanacetin*. It also contains tannin, fat, resin, etc.

ARNICÆ FLORES. *U.S.* Arnica Flowers.

The flower-heads of *Arnica montana* Linné (Nat. Ord. *Compositæ*).

Arnica flowers contain a trace of volatile oil, and a bitter principle, *arnicin*, with resin, coloring-matter, etc. Alcohol and water extract their virtues.

Officinal Preparation.

Tinctura Arnicæ Florum (Tincture of Arnica Flowers). Made by percolating 20 parts of powdered arnica flowers with sufficient diluted alcohol to make 100 parts (see page 304).

ARNICÆ RADIX. *U.S.* Arnica Root.

The rhizome and rootlets of *Arnica montana* Linné (Nat. Ord. *Compositæ*).

This rhizome contains about 1 per cent. of volatile oil, the bitter principle *arnicin*, acrid resin, tannin, etc.

Officinal Preparations.

Extractum Arnicæ Radicis (Extract of Arnica Root). Made by percolating powdered arnica root with diluted alcohol, evaporating the percolate to pilular consistence, and adding 5 per cent. of glycerin (see page 378). Dose, three to five grains.

Emplastrum Arnicæ (Arnica Plaster). Made by mixing 50 parts of extract of arnica root with 100 parts of melted resin plaster. (See Emplastra.)

Extractum Arnicæ Radicis Fluidum (Fluid Extract of Arnica Root). Made with diluted alcohol (see page 336). Dose, five to ten minims.

Tinctura Arnicæ Radicis (Tincture of Arnica Root). Made by percolating 10 parts of arnica root with sufficient diluted alcohol to make 100 parts (see page 304). Dose, twenty minims to half a fluidrachm.

CALENDULA. *U.S.* Calendula. [MARIGOLD.]

The fresh, flowering herb of *Calendula officinalis* Linné (Nat. Ord. *Compositæ*).

Calendula contains a small quantity of a volatile oil, a bitter principle, gum, sugar, etc. *Calendulin* is not the active principle, having very little taste.

Officinal Preparation.

Tinctura Calendulæ (Tincture of Calendula). Made by percolating 20 parts of powdered calendula with sufficient diluted alcohol to make 100 parts (see page 306). Used externally.

OLEUM ERIGERONTIS. *U.S.* **Oil of Erigeron.** [OIL OF FLEABANE.]

A volatile oil distilled from the fresh, flowering herb of *Erigeron canadense* Linné (Nat. Ord. *Compositæ*).

It is a pale yellow liquid, becoming darker and thicker by age and exposure to air, having a peculiar, aromatic, persistent odor, an aromatic, slightly pungent taste, and a neutral reaction. Sp. gr. about 0.850. It is readily soluble in alcohol.

This oil consists of a terpene, $C_{10}H_{16}$, and an oxygenated portion. It is used in uterine hemorrhage as a hæmostatic. It is best administered in capsules.

INULA. *U.S.* **Inula.** [ELECAMPANE.]

The root of *Inula Helenium* Linné (Nat. Ord. *Compositæ*).

This root contains acrid resin and a volatile oil, which are the active principles. Helenin, C_6H_8O, is inert. *Inulin*, a kind of starch, is abundant (see page 665). Alcohol and water extract its virtues.

ANTHEMIS. *U.S.* **Anthemis.** [CHAMOMILE.]

The flower-heads of *Anthemis nobilis* Linné (Nat. Ord. *Compositæ*), collected from cultivated plants.

Anthemis owes its virtues to a volatile oil, and a bitter principle which has been called *anthemic acid.* The volatile oil is frequently blue in color. It is used as a tonic, often in infusion.

MATRICARIA. *U.S.* **Matricaria.** [GERMAN CHAMOMILE.]

The flower-heads of *Matricaria Chamomilla* Linné (Nat. Ord. *Compositæ*).

Matricaria contains a dark blue volatile oil, which is soluble in alcohol; the bitter principle is termed *anthemic acid.* It is used as a tonic and stimulant.

EUPATORIUM. *U.S.* **Eupatorium.** [THOROUGHWORT.]

The leaves and flowering tops of *Eupatorium perfoliatum* Linné (Nat. Ord. *Compositæ*).

This plant, known also as *boneset*, contains a volatile oil and resin, *eupatorin*, gum, tannin, sugar, etc. Alcohol, diluted alcohol, and water extract its virtues. It is tonic and laxative.

Officinal Preparation.

Extractum Eupatorii Fluidum . Made with a menstruum of diluted alcohol (see page 345).
Fluid Extract of Eupatorium. Dose, one to two fluidrachms.

GRINDELIA. *U.S.* **Grindelia.**

The leaves and flowering tops of *Grindelia robusta* Nuttall (Nat. Ord. *Compositæ*).

Grindelia contains a volatile oil and a bitter and resinous principle. Alcohol is the best menstruum.

Officinal Preparation.

Extractum Grindeliæ Fluidum . Made with a menstruum of 3 parts of alcohol and 1 part of
Fluid Extract of Grindelia. water (see page 348). Dose, one-half to one fluidrachm.

MEZEREUM. *U.S.* Mezereum.

The bark of *Daphne Mezereum* Linné, and of other species of *Daphne* (Nat. Ord. *Thymelaceæ*).

Mezereum contains *daphnin*, $C_{31}H_{34}O_{19}$, a glucoside, associated with an acrid soft resin and oil. Alcohol is the best menstruum for extracting the activity. It is rarely given internally alone, being usually combined with sarsaparilla and other drugs. The dose is five grains.

Officinal Preparations.

Extractum Mezerei Fluidum . Made with alcohol (see page 353). Dose, one minim. Used externally.
Fluid Extract of Mezereum.

Extractum Mezerei . . . . . Made with alcohol (see page 385). Used in compound liniment of mustard.
Extract of Mezereum.

Unguentum Mezerei . . . . . Made by adding 25 parts of fluid extract of mezereum to 80 parts of lard and 12 parts of yellow wax, melted together (see Unguenta).
Mezereum Ointment.

ASPIDIUM. *U.S.* Aspidium. [FILIX MAS, Pharm. 1870. MALE FERN.]

The rhizome of *Aspidium Filix-mas* Swartz, and of *Aspidium marginale* Willdenow (Nat. Ord. *Filices*).

Aspidium contains *filicic acid*, $C_{14}H_{18}O_5$, filix red, filitannic acid, fixed oil, etc. It is used as a tænifuge in the form of oleoresin. The green portions of the rhizome alone are active.

Officinal Preparation.

Oleoresina Aspidii . . . Made by exhausting aspidium with stronger ether, distilling and evaporating (see page 367). Yield, 10 to 15 per cent. Dose, one-half to one fluidrachm.
Oleoresin of Aspidium.

CYPRIPEDIUM. *U.S.* Cypripedium. [LADIES' SLIPPER.]

The rhizome and rootlets of *Cypripedium pubescens* Willdenow, and of *Cypripedium parviflorum* Salisbury (Nat. Ord. *Orchidaceæ*).

This rhizome contains resins, an acid principle, volatile oil, tannin, starch, etc. Alcohol extracts its virtues. It is stimulant and diaphoretic, in doses of fifteen grains.

Officinal Preparation.

Extractum Cypripedii Fluidum . Made with alcohol (see page 343). Dose, fifteen minims.
Fluid Extract of Cypripedium.

PHYTOLACCÆ RADIX. *U.S.* Phytolacca Root. [POKE ROOT.]

The root of *Phytolacca decandra* Linné (Nat. Ord. *Phytolaccaceæ*).

This root contains an acrid resin, tannin, mucilage, etc. It is used as an alterative, in doses of twenty grains.

PHYTOLACCÆ BACCA. *U.S.* Phytolacca Berry. [POKE BERRY.]

The fruit of *Phytolacca decandra* Linné (Nat. Ord. *Phytolaccaceæ*).

This fruit contains reddish-purple coloring-matter, sugar, gum, etc. It is very little used in medicine, although said to be alterative and laxative.

STILLINGIA. *U.S.* Stillingia. [QUEEN'S ROOT.]

The root of *Stillingia sylvatica* Linné (Nat. Ord. *Euphorbiaceæ*).

Stillingia contains an acrid resin, starch, fixed oil, gum, etc. It is used as an alterative, in doses of twenty grains.

Officinal Preparation.

Extractum Stillingiæ Fluidum . Made with diluted alcohol (see page 362). Dose, fifteen to forty minims.
Fluid Extract of Stillingia.

MAGNOLIA. *U. S.* Magnolia.

The bark of *Magnolia glauca*, *Magnolia acuminata*, and *Magnolia tripetala* Linné (Nat. Ord. *Magnoliaceæ*).

This bark contains *magnolin*, a crystalline principle having an acrid taste, also pungent soft resin, tannin, etc. It is tonic and diaphoretic, in doses of thirty grains.

PYRETHRUM. *U. S.* Pyrethrum. [Pellitory.]

The root of *Anacyclus Pyrethrum* De Candolle (Nat. Ord. *Compositæ*).

This root contains an acrid brown resin and fixed oils, inulin, mucilage, etc. It is used as a sialagogue and stimulant, in doses of fifteen to forty grains.

Officinal Preparation.

Tinctura Pyrethri . . . . . Made by percolating 20 parts of pyrethrum with sufficient alcohol to make 100 parts (see page 318). It is used externally, and in tooth-washes.
Tincture of Pyrethrum.

XANTHOXYLUM. *U. S.* Xanthoxylum. [Prickly Ash.]

The bark of *Xanthoxylum fraxineum* Willdenow, and of *Xanthoxylum carolinianum* Lambert (Nat. Ord. *Rutaceæ*, *Xanthoxyleæ*).

Xanthoxylum owes its virtues to a soft resin, a crystalline resin, a bitter principle, and an acrid green oil. There are also present sugar, tannin, gum, etc. It is a sialagogue, stimulant, and alterative. Dose, fifteen grains.

Officinal Preparation.

Extractum Xanthoxyli Fluidum. . Made with alcohol (see page 365). Dose, one-half to one fluidrachm.
Fluid Extract of Xanthoxylum.

IRIS. *U. S.* Iris. [Blue Flag.]

The rhizome and rootlets of *Iris versicolor* Linné (Nat. Ord. *Iridaceæ*).

The acridity of iris is due to the presence of a bitter resin. There are also present sugar, gum, tannin, and fatty matter. Iris is an alterative and emetic. Dose, fifteen grains.

Officinal Preparations.

Extractum Iridis Fluidum . Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 350). Dose, five to ten minims.
Fluid Extract of Iris.

Extractum Iridis . . . . . Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 383). Dose, one to two grains.
Extract of Iris.

CIMICIFUGA. *U. S.* Cimicifuga. [Black Snakeroot.]

The rhizome and rootlets of *Cimicifuga racemosa* Elliott (Nat. Ord. *Ranunculaceæ*).

Cimicifuga contains resin, an acrid principle (possibly an alkaloid), starch, tannin, gum, etc. It is used as a sedative and alterative, in doses of thirty grains.

Officinal Preparations.

Extractum Cimicifugæ Fluidum . Made with a menstruum of alcohol (see page 341). Dose, thirty to sixty minims.
Fluid Extract of Cimicifuga.

Tinctura Cimicifugæ . . . . . Made by percolating 20 parts of cimicifuga with sufficient alcohol to make 100 parts (see page 308). Dose, one to four fluidrachms.
Tincture of Cimicifuga.

PULSATILLA. *U. S.* Pulsatilla.

The herb of *Anemone Pulsatilla* and *Anemone pratensis* Linné, and of *Anemone patens* Linné, var. *Nuttalliana* Gray (Nat. Ord. *Ranunculaceæ*), collected soon after flowering.

It should be carefully preserved, and not be kept longer than one year. Pulsatilla contains an acrid, odorous, resinous substance, coloring-matter, gum, etc. The acrid principle may be converted into *anemonin*, $C_{15}H_{12}O_6$, which, through the action of alkalies, becomes anemonic acid. Alcohol is the best menstruum to extract its virtues. It is irritant and diaphoretic, in doses of thirty to fifty grains.

APOCYNUM. *U. S.* Apocynum. [Canadian Hemp.]

The root of *Apocynum cannabinum* Linné (Nat. Ord. *Apocynaceæ*).

Apocynum contains resin, *apocynin*, *apocynein*, bitter extractive, tannin, etc. Alcohol is a good menstruum for it. It is emetic and antiperiodic. Dose, five to twenty grains.

ASCLEPIAS. *U. S.* Asclepias. [Pleurisy Root.]

The root of *Asclepias tuberosa* Linné (Nat. Ord. *Asclepiadaceæ*).

This root contains resins, volatile principle, tannin, mucilage, etc. Diluted alcohol extracts its virtues. It is used as an expectorant and anodyne, in doses of thirty grains.

LACTUCARIUM. *U. S.* Lactucarium.

The concrete milk-juice of *Lactuca virosa* Linné (Nat. Ord. *Compositæ*).

Lactucarium is a complex substance. It contains a bitter resinous principle, *lactucin*, $C_{11}H_{12}O_3.H_2O$, *lactucic acid* (bitter and crystalline), *lactucopicrin* (bitter and amorphous), *lactucerin* in large quantity, nearly 60 per cent. (this principle is inert and crystallizable), caoutchouc, resin, asparagin, volatile oil, mucilage, etc. It is used as a sedative, in doses of three grains.

Officinal Preparations.

Extractum Lactucarii Fluidum . Lactucarium is treated with ether, alcohol, and water, the ether to extract the inert lactucerin, then the alcohol and water to dissolve the bitter active principles (see page 351). Dose, five minims.
Fluid Extract of Lactucarium.

Syrupus Lactucarii . . . . . Made by mixing 5 parts of fluid extract of lactucarium with 95 parts of syrup (see page 264). Dose, a fluidrachm.
Syrup of Lactucarium.

Unofficinal Products containing Volatile Oil, Bitter Principle, and Extractive.

Achillea.
Yarrow. — A perennial herb of the order Compositæ, *Achillea Millefolium*, growing in America and Europe. It contains achilleine.

Oleum Achilleæ.
Oil of Yarrow. — A blue or dark-green volatile oil. The yield is about $\frac{1}{10}$ per cent.

Unofficinal Products containing Volatile Oil, Bitter Principle, and Extractive.— (*Continued.*)

Angustura. Angustura Bark.	The bark of *Galipea Cusparia*, from the mountains near the Orinoco River.
Oil of Angustura, $C_{13}H_{24}O$.	The yield of oil is about ½ per cent.
Apocynum Androsæmifolium. Dogsbane.	A root which grows in New England and Canada.
Artemisia. Mugwort.	From *Artemisia vulgaris*. It contains volatile oil, bitter principle, etc.
Bela. Bael.	From *Ægle Marmelos*, grown in the Himalaya Mountains. It contains tannin, bitter principle, and volatile oil.
Boldus. Boldo.	From *Boldus fragrans*, grown in Chili. It contains volatile oil, glucoside, etc.
Chekan. Cheken.	The leaves of *Eugenia Chekan*, grown in Chili. It contains volatile oil, bitter principle, etc.
Clematis. Virgin's Bower.	The herb from different species of *Clematis*.
Coto. Coto Bark.	A bark belonging to the Lauraceæ. It contains cotoin, $C_{22}H_{18}O_6$, and paracotoin.
Oil of Coto Bark.	A pale yellow oil of a peppery taste.
Erigeron. Erigeron.	The leaves and tops of *Erigeron canadense*.
Eriodictyon. Mountain Balm.	The leaves of *Eriodictyon californicum*.
Euphrasia. Eyebright.	*Euphrasia officinalis*, indigenous to Europe.
Genista. Dyers' Broom.	The young branches of *Genista tinctoria*, indigenous to Asia and Europe. It contains a yellowish-green volatile oil.
Geum. Water Avens.	The rhizome of *Geum rivale*, grown in America and Europe. It contains volatile oil and bitter principle.
Gnaphalium. Life-Everlasting.	From different species of *Gnaphalium*, grown in North America. It contains volatile oil and bitter principle.
Helianthemum. Frostwort.	The herb of *Helianthemum canadense*, indigenous to Canada. It contains a bitter principle.
Hypericum. St. John's Wort.	From *Hypericum perforatum*, grown in Europe. It contains hypericum red, volatile oil, etc.
Parthenium. Feverfew.	The flowering herb of *Pyrethrum Parthenium*, growing in waste places in Europe. It contains volatile oil and bitter principle.
Primula. Primrose.	From *Primula officinalis*, indigenous to Europe and Asia. It contains a volatile oil and primulin.
Ranunculus. Crowfoot.	From *Ranunculus bulbosus*, found in North America. It contains a golden-yellow volatile oil and a bitter principle.
Rhamnus Purshiana (Cascara Sagrada, Chittem Bark, Sacred Bark).	From *Rhamnus purshiana*, found on the west coast of North America. It contains a volatile oil, brown resin, etc.
Senecio. Groundsel.	From *Senecio aureus*, grown in Europe. It contains bitter principle, etc.
Teucrium. Germander.	From *Teucrium Marum*, indigenous to Europe. It contains volatile oil and bitter principle.
Tilia. Linden Flowers.	From *Tilia americana*. It contains volatile oil, bitter principle, etc.
Trillium. Beth Root.	The rhizome of *Trillium erectum*. It contains resinous, fatty, and acrid principles, etc.
Turnera. Damiana.	The leaves of *Turnera microphylla*. It contains volatile oil, resin, etc.
Verbascum. Mullein.	The flowers of *Verbascum phlomoides*, found in Europe. It contains volatile oil, etc.

CHAPTER LVII.

RESINS, OLEORESINS, GUM-RESINS, AND BALSAMS.

RESINS are natural or induced solid or semi-solid exudations from plants, characterized by being insoluble in water, mostly soluble in alcohol, uncrystallizable, and softening or melting at a moderate heat. They are usually the *oxidized terpenes* of plants, and, owing to their insolubility in water, have little taste; they are, chemically, mixed products; some of them are acids, and combine with alkalies, forming soaps, as in the case of common rosin.

Resins, when pure, are usually transparent; when they contain water, they are opaque, and no longer hard and brittle.

Natural Oleoresins are mixtures of oils and resin, generally obtained by incising the trunks of the trees from which they are obtained: as turpentine, copaiba, etc.

Gum-resins are natural mixtures of gum and resin, usually obtained as exudations from plants: as myrrh, asafetida, etc.

Balsams are resinous substances which contain benzoic, cinnamic, or an analogous acid: as balsam of tolu, etc.

The officinal resins, oleoresins, gum-resins, and balsams will now be considered, followed by a condensed table of unofficinal allied products.

TEREBINTHINA. *U. S.* Turpentine.

A concrete oleoresin obtained from *Pinus australis* Michaux, and from other species of *Pinus* (Nat. Ord. *Coniferæ*).

White turpentine contains abietic anhydride, which may be converted into abietic acid, $C_{44}H_{64}O_5$, a bitter principle, and 25 per cent. of volatile oil. It is used as an ingredient in plasters (see Emplastrum Galbani), and is sometimes administered in pill form. Dose, fifteen to thirty grains.

OLEUM TEREBINTHINÆ. *U. S.* Oil of Turpentine.

A volatile oil distilled from Turpentine.

This important oil has the composition $C_{10}H_{16}$, and, as has been already stated, is the type of the terpenes.

It is a thin, colorless liquid, of a characteristic odor and taste, becoming stronger and less pleasant by age and exposure to air, and of a neutral or faintly acid reaction. Sp. gr. 0.855 to 0.870. It is soluble in 6 parts of alcohol. Bromine and powdered iodine act violently upon it. When brought in contact with a mixture of nitric and sulphuric acids, it takes fire. It is used as a solvent for resins, etc., and is the one selected in cantharides liniment for dissolving the cantharidin (see page 287).

Officinal Preparation.

Linimentum Terebinthinæ (Turpentine Liniment). Made by mixing 65 parts of resin cerate with 35 parts of oil of turpentine (see page 288).

RESINA. *U. S.* Resin. [COLOPHONY.]

The residue left after distilling off the volatile oil from Turpentine.

Resin consists of abietic anhydride, which passes into abietic acid when treated with diluted alcohol. It is a transparent, amber-colored substance, hard, brittle, with a glossy and shallow conchoidal fracture, and having a faintly terebinthinate odor and taste. Sp. gr. 1.070 to 1.080. It melts at about 135° C. (275° F.), and is soluble in alcohol, ether, and fixed or volatile oils. It is used to give adhesiveness to plasters, and in cerates and ointments, as in cantharides cerate, cerate of the extract of cantharides, and mercurial plaster.

Officinal Preparations.

Ceratum Resinæ (Resin Cerate). . . . Made by melting together 35 parts of resin, 15 parts of yellow wax, and 50 parts of lard. (See Cerata.)

Emplastrum Resinæ (Resin Plaster). Made by melting together 14 parts of resin, 80 parts of lead plaster, and 6 parts of yellow wax. (See Emplastra.)

TEREBINTHINA CANADENSIS. *U. S.* Canada Turpentine. [BALSAM OF FIR.]

A liquid oleoresin obtained from *Abies balsamea* Marshall (Nat. Ord. *Coniferæ*).

Canada turpentine contains resin, associated with a terpene, $C_{10}H_{16}$, and a small quantity of a bitter principle. It is a yellowish or faintly greenish, transparent, viscid liquid, of an agreeable terebinthinate odor, and a bitterish, slightly acrid taste; slowly drying on exposure, and then forming a transparent mass; completely soluble in ether, chloroform, or benzol. It is used principally as an external application and for mounting microscopic objects.

MASTICHE. *U. S.* Mastic.

A concrete resinous exudation from *Pistacia Lentiscus* Linné (Nat. Ord. *Terebinthaceæ*, *Anacardieæ*).

Mastic contains a resin (masticbic acid, $C_{20}H_{32}O_2$), which is soluble in strong alcohol; also masticin, a resinous principle which is insoluble in alcohol; a small quantity of volatile oil is likewise present. It is used in pills of aloes and mastic to modify the action of the aloes; in the arts it is employed to form a varnish.

PIX BURGUNDICA. *U. S.* Burgundy Pitch.

The prepared, resinous exudation of *Abies excelsa* De Candolle (Nat. Ord. *Coniferæ*).

Burgundy pitch contains resin, a small quantity of a terpene, $C_{10}H_{16}$, and water. It is almost entirely soluble in glacial acetic acid. It is used as a basis for plasters.

Officinal Preparations.

Emplastrum Picis Burgundicæ (Burgundy Pitch Plaster). . . . Made with 90 parts of Burgundy pitch and 10 parts of yellow wax.

Emplastrum Picis cum Cantharide (Pitch Plaster with Cantharides). Made by melting together 92 parts of Burgundy pitch and 8 parts of cerate of cantharides.

PIX CANADENSIS. *U. S.* Canada Pitch. [Hemlock Pitch.]

The prepared, resinous exudation of *Abies canadensis* Michaux (Nat. Ord. *Coniferæ*).

Hemlock pitch contains resins, a small quantity of a terpene, $C_{10}H_{16}$, and water. It is used in making the so-called "hemlock plaster."

Officinal Preparation.

Emplastrum Picis Canadensis . Made by melting together 90 parts of Canada pitch and 10 parts of yellow wax. (See Emplastra.)
Canada Pitch Plaster.

GUTTA-PERCHA. *U. S.* Gutta-Percha.

The concrete exudation of *Isonandra Gutta* Hooker (Nat. Ord. *Sapotaceæ*).

This substance consists almost entirely of resinous substances, one of which is crystalline. Gutta-percha is insoluble in water or alcohol, but soluble in chloroform, benzol, benzin, disulphide of carbon, or oil of turpentine.

Officinal Preparation.

Liquor Gutta-Perchæ . . . Made by dissolving 9 parts of gutta-percha in 70 parts of chloroform, adding 10 parts of carbonate of lead and 30 parts of chloroform, and decanting the solution (see page 253).
Solution of Gutta-Percha.

AMMONIACUM. *U. S.* Ammoniac.

A gum-resin obtained from *Dorema Ammoniacum* Don (Nat. Ord. *Umbelliferæ*, *Orthospermæ*).

Ammoniac is a gum-resin. It contains about 25 per cent. of gum, 70 per cent. of resin, and about 3 per cent. of volatile oil. The resin is remarkable for yielding resorcin when fused with potassa. With water it forms an emulsion. It is partially soluble in acetic acid. It is used as an expectorant and stimulant. Dose, fifteen grains.

Officinal Preparations.

Mistura Ammoniaci . . . . . Made by rubbing 4 parts of ammoniac with 100 parts of water (see page 272). Dose, half a fluidounce.
Ammoniac Mixture.

Emplastrum Ammoniaci . . . . . Made by digesting 100 parts of ammoniac with 140 parts of diluted acetic acid until it is emulsionized, straining and evaporating. (See Emplastra.)
Ammoniac Plaster.

Emplastrum Ammoniaci cum Hydrargyro . 720 parts ammoniac; 180 parts mercury; 8 parts olive oil; 1 part sublimed sulphur; diluted acetic acid, and lead plaster. (See Emplastra.)
Ammoniac Plaster with Mercury.

ASAFŒTIDA. *U. S.* Asafetida.

A gum-resin obtained from the root of *Ferula Narthex* Boissier, and of *Ferula Scorodosma* Bentham et Hooker (Nat. Ord. *Umbelliferæ*, *Orthospermæ*).

This gum-resin contains a sulphurated volatile oil (ferulyl sulphide), about 20 per cent. of gum, and 70 per cent. of resin. The gum is partially soluble in water; the resin is soluble in alcohol, and yields resorcin by treatment with potassa, and umbelliferone by dry distillation. The valuable principles in asafetida are soluble in alcohol; with water an emulsion may be formed, which possesses its virtues. It is used as an antispasmodic. Dose, ten grains.

Officinal Preparations.

Mistura Asafœtidæ . . . Made by rubbing 4 parts of asafetida with 100 parts of water (see Asafetida Mixture. page 272). Dose, half a fluidounce.
Tinctura Asafœtidæ . . Made by macerating 20 parts of asafetida with 80 parts of alcohol, Tincture of Asafetida. and adding sufficient alcohol to make 100 parts (see page 305).
Emplastrum Asafœtidæ . Made from 35 parts each of asafetida and lead plaster, and 15 parts Asafetida Plaster. each of galbanum and yellow wax. (See Emplastra.)
Pilulæ Asafœtidæ . . . Each pill contains 3 grains of asafetida and 1 grain of soap. Pills of Asafetida.

MYRRHA. *U. S.* Myrrh.

A gum-resin obtained from *Balsamodendron Myrrha* Nees (Nat. Ord. *Burseraceæ*).

Myrrh is a gum-resin, and contains 3 per cent. of an oxygenated volatile oil, a bitter principle, and about 30 per cent. of gum and 60 per cent. of resin. Alcohol is the best solvent for the oil and resin, which are its active principles. The gum left after macerating myrrh in alcohol may be used for making a good mucilage. Myrrh is stimulant, tonic, and vulnerary. Dose, twenty grains. It is used in compound myrrh mixture, pills, etc. (See Condensed Chart at the end of this part.)

Officinal Preparation.

Tinctura Myrrhæ . . Made by macerating 20 parts of myrrh with alcohol to obtain 100 parts Tincture of Myrrh. (see page 316). Used externally.

GALBANUM. *U. S.* Galbanum.

A gum-resin obtained from *Ferula galbaniflua* Boissier et Buhse, and probably from other allied plants (Nat. Ord. *Umbelliferæ*, *Orthospermæ*).

Galbanum contains 8 per cent. of volatile oil ($C_{10}H_{16}$), 20 per cent. of gum, and 65 per cent. of resin, which is converted into resorcin by treatment with potassa, and which yields umbelliferone by dry distillation. *Umbelliferone*, $C_9H_6O_3$, is remarkable for imparting to the solution in cold water a blue fluorescence upon the addition of a little water of ammonia. Galbanum, like camphor, has the property of softening hard resinous substances with which it is mixed, and is useful in plasters and pills on this account. It is used as an antispasmodic. Dose, fifteen grains.

Officinal Preparations.

Emplastrum Galbani . . . . . 16 parts galbanum, 2 parts turpentine, 6 parts Burgundy Galbanum Plaster. pitch, 76 parts lead plaster. (See Emplastra.)
Pilulæ Galbani Compositæ . . . Each pill contains 1½ grains each of galbanum and myrrh Compound Pills of Galbanum. and ½ grain of asafetida.

GUAIACI LIGNUM. *U. S.* Guaiacum Wood.

The heart-wood of *Guaiacum officinale* Linné, and of *Guaiacum sanctum* Linné (Nat. Ord. *Zygophyllaceæ*).

This wood owes its virtues to resin, which is present usually to the amount of 25 per cent. It is regarded as an alterative, anti-rheumatic, and diaphoretic. Dose, thirty to sixty grains. It is an ingredient in both the compound decoction and the compound syrup of sarsaparilla.

GUAIACI RESINA. *U. S.* Guaiac.

The resin of the wood of *Guaiacum officinale* Linné (Nat. Ord. *Zygophyllaceæ*).

This resin is usually prepared by boiling guaiac chips in salt water: the resinous scum is collected, melted, and strained. It consists of

guaiacic acid ($C_{12}H_{16}O_6$), *guaiaconic acid* ($C_{19}H_{20}O_5$), *guaiaretic acid* ($C_{20}H_{26}O_4$), beta resin, gum, etc. Alcohol and alkaline solutions are the best solvents for guaiac. A solution of guaiac resin is colored blue by oxidizing agents, due to the presence of guaiaconic acid. This resin is anti-rheumatic, in doses of fifteen grains.

Officinal Preparations.

Tinctura Guaiaci . . . . . Made by macerating 20 parts of guaiac in alcohol, filtering, and adding sufficient alcohol to make 100 parts. The officinal direction to macerate *seven days* is unnecessary; it should be macerated until dissolved; twenty-four hours is often sufficient time (see page 312). Dose, one to two fluidrachms.
Tincture of Guaiac.

Tinctura Guaiaci Ammoniata . . . Made by macerating 20 parts of guaiac in aromatic spirit of ammonia to obtain 100 parts (see page 312). Dose, one to two fluidrachms.
Ammoniated Tincture of Guaiac.

BALSAMUM TOLUTANUM. *U. S.* Balsam of Tolu.

A balsam obtained from *Myroxylon toluifera* Kunth (Nat. Ord. *Leguminosæ*, *Papilionaceæ*).

Balsam of tolu contains *cinnamic* and *benzoic acids*, resins, a volatile oil called *benzyl benzoate*, $C_7H_5(C_7H_7)O_2$, *benzyl cinnamate*, a terpene, $C_{10}H_{16}$, termed *tolene*, and other unimportant constituents. It is used as a stimulant and expectorant. Alcohol is the best solvent; it is almost insoluble in benzin. Warm disulphide of carbon removes from the balsam scarcely anything but cinnamic and benzoic acids. On evaporating the disulphide, no substance having the properties of resin should remain.

Officinal Preparations.

Tinctura Tolutana . Made by dissolving 10 parts of balsam of tolu in enough alcohol to make 100 parts (see page 320). Dose, one fluidrachm.
Tincture of Tolu.

Syrupus Tolutanus . Made by digesting 4 parts of balsam of tolu with 35 parts of distilled water in which 65 parts of sugar have been dissolved, straining, and making up to 100 parts with water (see page 268).
Syrup of Tolu.

BALSAMUM PERUVIANUM. *U. S.* Balsam of Peru.

A balsam obtained from *Myroxylon Pereiræ* Klotzsch (Nat. Ord. *Leguminosæ*, *Papilionaceæ*).

Balsam of Peru contains *cinnamic* and *benzoic acids*, *benzyl cinnamate*, $C_9H_7(C_7H_7)O_2$, resin, *benzyl benzoate*, stilbene, etc.

Balsamum Peruvianum. *U. S.*	Odor and Taste.	Solubility.	
		Alcohol.	Other Solvents.
A thick liquid, brownish black in bulk, reddish brown and transparent in thin layers, having a syrupy consistence.	Somewhat smoky, but agreeable and balsamic odor; warm, bitter, afterwards acrid taste.	5 parts.	Miscible with absolute alcohol, chloroform, or glacial acetic acid.

Tests for Identity.	Impurities.	Tests for Impurities.
If 1 volume of the Balsam be triturated with 2 volumes of sulphuric acid, a tough, homogeneous, cherry-red mixture should result. If this be washed, after a few minutes, with cold water, it should be converted into a resinous mass which is brittle when cold. A mixture of 3 parts of the Balsam with 1 part of disulphide of carbon remains clear; but a mixture of 1 part of the Balsam with 3 parts of disulphide of carbon separates from the Balsam about 40 per cent. of resin. When distilled with 200 times its weight of water, no volatile oil should pass over.	Gurjun Balsam.	The liquid poured off from a mixture of 1 part of Balsam of Peru with 3 parts of disulphide of carbon should be transparent, should not have a deeper color than light brownish, and should not exhibit more than a faint fluorescence.
	Fixed Oils and Alcohol.	Balsam of Peru should not diminish in volume when agitated with an equal bulk of benzin or water.

Uses.—Balsam of Peru is very apt to be adulterated. It is used as a preservative for fats, ointments, etc.; internally, it is stimulant and aromatic.

BENZOINUM. *U.S.* Benzoin.

A balsamic resin obtained from *Styrax Benzoin* Dryander (Nat. Ord. *Styraceæ*).

Benzoin contains benzoic acid, cinnamic acid ($C_9H_8O_2$), a fragrant volatile oil, and resins: in some varieties vanillin is found. Alcohol is the best solvent for its active principles. It is a valuable stimulant and expectorant. Dose, thirty grains.

Officinal Preparations.

Adeps Benzoinatus . . . . . Made by digesting 2 parts of benzoin tied in a piece of coarse muslin in 100 parts of melted lard.
Benzoinated Lard.

Tinctura Benzoini . . . . . Made by macerating 20 parts of benzoin in alcohol to obtain 100 parts (see page 305). Dose, thirty minims.
Tincture of Benzoin.

Tinctura Benzoini Composita . . Made by macerating 12 parts benzoin, 2 parts purified aloes, 8 parts storax, and 4 parts balsam of tolu in alcohol to obtain 100 parts (see page 306). Dose, thirty minims.
Compound Tincture of Benzoin.

STYRAX. *U.S.* Storax.

A balsam prepared from the inner bark of *Liquidambar orientalis* Miller (Nat. Ord. *Hamamelaceæ*, *Balsamifluæ*).

Storax contains cinnamic acid, benzoic acid, *styracin*, $C_9H_7(C_9H_9)O_2$, *storesin*, $C_{36}H_{58}O_3$, *ethyl cinnamate*, $C_9H_7(C_2H_5)O_2$, *phenyl-propyl cinnamate*, $C_9H_7(C_9H_{17})O_2$, *styrol*, C_8H_8, a fragrant hydrocarbon, and a resinous substance not yet investigated. A large quantity of water is usually present. Storax is used in compound tincture of benzoin. It is stimulant and expectorant. It may be used, like benzoin, to protect fatty substances from rancidity.

ACIDUM BENZOICUM. *U.S.* Benzoic Acid.

$HC_7H_5O_2$; 122.

Preparation.—Benzoic acid is found naturally in benzoin, balsam of tolu, balsam of Peru, gum acroides, storax, and other resinous substances. It may be obtained from these by the process described on

page 139; but, owing to the small yield afforded in this way, commercial benzoic acid is now largely made artificially in several ways:

1. From the urine of cattle, by mixing it with lime in excess, evaporating and decomposing the lime hippurate with hydrochloric acid. The separated hippuric acid, after purification with animal charcoal, is treated with hydrochloric acid, when benzoic acid and *glycocine* are produced, the hydrochloric acid not being decomposed.

$$\underset{\text{Hippuric Acid.}}{C_9H_9NO_3} + \underset{\text{Water.}}{H_2O} = \underset{\text{Benzoic Acid.}}{C_7H_6O_2} + \underset{\text{Glycocine.}}{C_2H_5NO_2}.$$

The benzoic acid is sometimes sublimed with benzoin to mask its disagreeable odor and imitate the acid sublimed from benzoin.

2. Benzoic acid is made from *naphthalin*, $C_{10}H_8$, which, on treatment with nitric acid, yields *phthalic acid;* this, when heated with excess of calcium hydrate, yields calcium benzoate and carbonate.

$$\underset{\text{Phthalic Acid.}}{C_8H_6O_4} = \underset{\text{Benzoic Acid.}}{C_7H_6O_2} + \underset{\text{Carbon Dioxide.}}{CO_2}.$$

3. Benzoic acid is also made from trichlormethyl-benzol, a compound obtained from toluol, C_7H_8, a coal-tar hydrocarbon. By heating it with zinc chloride and acetic acid, benzoic acid is formed, hydrochloric acid being liberated at the same time.

Acidum Benzoicum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
White, lustrous scales, or friable needles, permanent in air. Strongly heated, the Acid is completely volatilized. If gradually heated in a retort with 3 parts of freshly slaked lime, benzol is evolved.	Slight aromatic odor of benzoin; a warm, acid taste; acid reaction.	Cold. 500 parts. Boiling. 15 parts.	Cold. 3 parts. Boiling. 1 part.	In 3 parts of ether, 7 parts of chloroform, and readily soluble in disulphide of carbon, benzol, benzin, and oils; freely soluble in solutions of potassa, soda, and ammonia.

Test for Identity.	Impurities.	Tests for Impurities.
On carefully neutralizing any of the solutions of potassa, soda, or ammonia, and adding solution of ferric sulphate previously diluted with water, a flesh-colored precipitate is produced.	Organic Impurities.	The solution of the Acid in pure, cold sulphuric acid, when gently warmed, should not turn darker than light brownish; if now poured into water, the Benzoic Acid should separate as a white precipitate, and the liquid should be colorless.
	Chlorobenzoic Acid.	A small quantity of the Acid, when taken up by some recently ignited and moistened cupric oxide, held in the loop of a platinum wire and introduced into a non-luminous flame, should not impart a green or bluish-green color to the flame.
	Cinnamic Acid.	The Acid should not have an odor resembling that of bitter almonds or of stale urine. On rubbing together 1 Gm. of the Acid and 0.5 Gm. of permanganate of potassium in a mortar with a few drops of water, the odor of oil of bitter almonds should not be evolved.

Uses.—This acid is useful in forming *benzoates*, a class of salts which have been employed frequently during the last few years. It is stimulant, expectorant, and irritant to the mucous membranes. Dose. ten grains, administered in thick mucilage or syrup.

Unofficinal Substances containing Resins.

Bdellium. Bdellium	From *Balsamodendron Mukul*, grown in India. It contains volatile oil and resin.
Elemi. Elemi.	From *Canarium commune*, grown in the Philippine Islands. It contains 10 per cent. of volatile oil, $C_{10}H_{16}$, and 25 per cent. of resin.
Euphorbium. Euphorbium.	From *Euphorbium resinifera*, found in Morocco. It contains 18 per cent. of gum and 38 per cent. of resin, etc.
Gurjun. Wood Oil.	From *Dipterocarpus turbinatis*. It contains about 40 per cent. of volatile oil and resin.
Olibanum. Frankincense.	From several species of *Boswellia*, found in Africa. It contains 6 per cent. of volatile oil and 56 per cent. of resin.
Resina Draconis. Dragon's Blood.	The resin from the fruit of *Calamus Draco*. It contains a peculiar resin, $C_{20}H_{20}O_3$, etc.
Resina Elastica, $C_{20}H_{32}$. India Rubber.	From *Siphonia elastica*, found in South America. The juice, by combination with sulphur, furnishes ordinary soft rubber; this, upon heating, becomes hard rubber. It yields on destructive distillation caoutchoucin.

Eclectic Resinoids.

These so-called active principles are made by adding a concentrated alcoholic fluid extract of the drug to a large quantity of water, and collecting the precipitate: they are largely used by the eclectic practitioners, and vary greatly in properties and effects. *They must not be confounded with true active principles*, although the names are often exactly the same: this fact often leads to annoyance in dispensing, and has been the cause of dangerous mistakes. A list of the *resinoids* most frequently used is appended.

Alnuin.	From the bark of *Alnus rubra*. The dose is about one to three grains.
Ampelopsin.	From the branches and bark of *Ampelopsis quinquefolia*. The dose is from two to eight grains.
Apocynin.	From the root of *Apocynum androsæmifolium*. It yields about one ounce of apocynin from two pounds of drug. The dose is from one-half to two grains.
Asclepidin.	From the root of *Asclepias tuberosa*. The dose is from one to five grains.
Baptisin.	From the root of *Baptisia tinctoria*. It is of a yellowish-brown color. The dose is from one-third to one grain.
Barosmin.	From the leaves of *Barosma betulina* and other species. The dose is from one to four grains.
Caulophyllin.	From the root of *Caulophyllum thalictroides*. It yields about 12 per cent. of caulophyllin. The dose is from one-quarter to one grain.
Ceanothin.	From the root of *Ceanothus americanus*.
Cerasein.	From the bark of *Cerasus virginiana*. The dose is from five to ten grains.
Chelonin.	From the herb of *Chelone glabra*. The dose is from one to two grains.
Chimaphilin.	From the leaves of *Chimaphila umbellata*. The dose is from one to four grains.
Cimicifugin.	From the rhizome of *Cimicifuga racemosa*. It yields about 5 per cent. The dose is from one to six grains. It is also called Macrotin.
Collinsonin.	From the herb of *Collinsonia canadensis*. The dose is about three grains.
Cornin.	From the bark of the root of *Cornus florida*. The dose is about five grains.
Corydaline.	From the tubers of *Dicentra canadensis*. It yields about one-half ounce of corydaline from two pounds of the tubers. The dose is from one-half to two grains.
Cypripedin.	From the rhizome of *Cypripedium pubescens*. The dose is about two grains.
Dioscorein.	From the root of *Dioscorea villosa*. The dose is from two to five grains.
Euonymin.	From the bark of *Euonymus atropurpureus*. The dose is from one-fourth to four grains.
Eupatorin.	From the leaves and flowering tops of *Eupatorium perfoliatum*. The dose is from two to four grains.
Euphorbin.	From the root of *Euphorbia corollata*. The dose is from one-half to two grains.
Fraserin.	From the root of *Frasera Walteri*. The dose is from one to five grains.

Eclectic Resinoids.—(*Continued.*)

Gelsemin.	From the rhizome of *Gelsemium sempervirens*. The dose is from one-half to two grains.
Hamamelin.	From the root of *Hamamelis virginica*. The dose is about five grains.
Helonin.	From the root of *Helonias dioica*. The dose is from one-half to two grains.
Hydrastin.	From the rhizome of *Hydrastis canadensis*. The dose is from three to five grains.
Juglandin.	From the bark of the root of *Juglans cinerea*. The dose is from two to five grains.
Leptandrin.	From the root of *Leptandra virginica*. The dose is from two to four grains.
Lupulin.	From the strobiles of *Humulus Lupulus*. The dose is from five to ten grains.
Lycopin.	From *Lycopus virginicus*. The dose is from three to five grains.
Macrotin.	See Cimicifugin.
Menispermin.	From *Menispermum canadense*. The dose is about two grains.
Myricin.	From *Myrica cerifera*. The dose is from two to eight grains.
Phytolaccin.	From *Phytolacca decandra*. The dose is from one-quarter to one grain.
Populin.	From the bark of *Populus tremuloides*. The dose is from two to five grains.
Prunin.	From *Cerasus serotina*. The dose is about two grains.
Ptelein.	From the root of *Ptelea trifoliata*.
Rhein.	From different species of *Rheum*. The dose is from two to four grains.
Rhusin.	From the leaves of *Rhus glabrum*. It is said to be a light brown powder.
Rumin.	From *Rumex crispus*. The dose is about two grains.
Sanguinarin.	From *Sanguinaria canadensis*. The dose is from one-half to two grains.
Scutellarin.	From the herb of *Scutellaria lateriflora*. The dose is from three to six grains.
Senecin.	From *Senecio gracilis*. The dose is from three to five grains.
Senecionin.	From *Senecio gracilis*. The dose is from one to five grains.
Smilasin.	From different species of *Smilax*. The dose is from two to five grains.
Stillingin.	From *Stillingia sylvatica*. The dose is one-half to one grain.
Trillin.	From *Trillium pendulum*. The dose is from three to six grains.
Viburnin.	From *Viburnum opulus*. The dose is about two grains.

CHAPTER LVIII.

FIXED OILS, FATS, AND SOAPS.

FIXED oils and fats are obtained from both the vegetable and the animal kingdom. They are greasy to the touch, and leave a permanent oily stain on paper; they are insoluble in water, but dissolve in ether, chloroform, carbon disulphide, benzol, benzin, turpentine, and volatile oils; they usually mix with one another without separating.

When pure, they are generally colorless or have a pale yellow color; they have a distinctive odor and taste, which is often caused by impurities with which they are associated, as the process of refining deprives them of odor and taste.

When heated moderately, if solid they melt, or if liquid they become thinner; if heated strongly in air they are decomposed, evolve offensive vapors, and then burn with a sooty flame, much heat being generated. Their specific gravity varies from 0.870 to 0.985, thus being lighter than water. By exposure to air they acquire an acrid, disagreeable taste and become acid to litmus paper. This change, termed *rancidity*, is believed to be due to the presence of impurities (like albuminous substances), which act as ferments, induce decomposition, liberate the fatty acids, and produce volatile, odorous acids, like caproic, caprylic, butyric, and valerianic acids. Oils which have become rancid may often be purified by shaking them thoroughly with hot water and then with a cold solution of sodium carbonate, and subsequently washing them with cold water.

Chemically, the fixed oils and fats are compound ethers of higher members of the fatty acids, the alcohol being glycerin and the radical glyceryl. In most cases they consist of two or three proximate principles,—olein, palmitin, or stearin. These are sometimes termed the glycerides of oleic, palmitic, and stearic acids. Olein is liquid, and palmitin and stearin are both solid: hence the consistence of fixed oils and fats is due to the relative proportion of these principles: thus, almond oil, being composed principally of olein, is always liquid at ordinary temperatures, whilst tallow, being largely stearin, is solid.

Olein, $C_3H_5(C_{18}H_{33}O_2)_3$, is the oleate of the triad radical glyceryl, and constitutes the liquid principle of oils. It is extremely difficult to obtain it pure. Being in most oils associated with the solids stearin and palmitin, it has to be separated by pressure and other mechanical means, and this is not easily effected. As ordinarily procured, therefore, olein contains more or less of palmitin or stearin, or both. It is obtained either by the agency of alcohol or by expression. When one of the oils, olive oil, for example, is dissolved in boiling alcohol, the solution, on cooling, deposits the concrete principles, retaining the olein, which it yields upon evaporation. The other method consists in compressing one

of the solid fats, or of the liquid oils rendered concrete by cold, between folds of bibulous paper, which absorb the olein, and give it up afterwards by compression under water. Olein is a liquid of oily consistence, congealing at —6° C. (21.2° F.), colorless when pure, with little odor and a sweetish taste, insoluble in water, soluble in boiling alcohol and ether.

Palmitin.—Palmitic acid occurs in the more liquid fats, such as palm oil and coco-nut oil, as glyceride; while in spermaceti and some forms of wax it is combined with monatomic alcohol radicals. Palmitin is the *glyceride of palmitic acid* or *tripalmitate of glyceryl.*

Stearin.—This exists abundantly in tallow and other animal fats, and it is made on an immense scale for use in candles by cooling lard and tallow, and separating the olein by hydraulic pressure. It may be obtained pure by dissolving suet in hot oil of turpentine, allowing the solution to cool, submitting the solid matter to expression in unsized paper, repeating the treatment several times, and finally dissolving in hot ether, which deposits the stearin on cooling. This is white, opaque in mass, but of a pearly appearance as crystallized from ether, pulverizable, fusible at 66.5° C. (152° F.), soluble in boiling alcohol and ether, but nearly insoluble in those liquids cold, and quite insoluble in water. It consists of glyceryl and stearic acid, as a glyceride, $C_3H_5(C_{18}H_{35}O_2)_3$, and has been formed synthetically by heating a mixture of these two materials to 280°–300° C.

Margarin.—What was long known under this name was shown by Heintz, in 1852, to be a mixture of stearin and palmitin. The true *margaric acid* has been obtained only by synthesis, not occurring in nature.

Stearic acid, $C_{18}H_{36}O_2$, is a firm white solid, like wax, fusible at 69.2° C. (157° F.), greasy to the touch, pulverizable, soluble in alcohol, very soluble in ether, but insoluble in water. In the impure state it is used as a substitute for wax in making wax candles. *Palmitic acid*, $C_{16}H_{32}O_2$, forms a white scaly mass, and melts at 62° C. (143.6° F.). *Oleic acid*, $C_{18}H_{34}O_2$, is an oily liquid, insoluble in water, soluble in alcohol and ether, lighter than water, crystallizable in needles a little below 0° C. (32° F.), and having a slight smell and a pungent taste. (See Acidum Oleicum.) *Glycerin* is described under a separate head. (See Glycerina.)

AMYGDALA DULCIS. *U. S.* Sweet Almond.

The seed of *Amygdalus communis* var. *dulcis* Linné (Nat. Ord. *Rosaceæ*, *Amygdaleæ*).

Sweet almond contains about 40 per cent. of fixed oils, protein compounds (*conglutin* and *amandin*), sugar, mucilage, etc. Tannin is present in the integuments.

The protein compounds aid in emulsionizing the fixed oil which is present, and simple trituration is all that is necessary to form a mixture.

Officinal Preparations.

Mistura Amygdalæ Almond Mixture. . Made by blanching 6 parts of almond, adding 1 part of acacia and 3 parts of sugar, and triturating with 100 parts of distilled water (see page 272). Dose, two to eight fluidounces.

Syrupus Amygdalæ Syrup of Almond. . Made from 10 parts of sweet almond, 3 parts of bitter almond, 50 parts of sugar, 5 parts of orange flower water, and water to make 100 parts (see page 260). Dose, one to two fluidounces.

OLEUM AMYGDALÆ EXPRESSUM. *U.S.* Expressed Oil of Almond.

A fixed oil expressed from Bitter or Sweet Almond.

Preparation.—This oil is obtained equally pure from sweet and bitter almonds. The almonds, having been deprived of a reddish-brown powder adhering to their surface, by being rubbed together in a piece of coarse linen, are ground in a mill, and then pressed in canvas sacks between plates of steel slightly heated. The oil, which is at first turbid, is clarified by rest and filtration. Sweet almond yields about 40 per cent. and bitter almond 35 per cent. of fixed oil.

A colorless oil may be obtained by expressing almonds which have been *blanched*,—*i.e.*, deprived of their testa by soaking them in hot water and slightly pressing them, and afterwards drying in a stove to evaporate the water.

Oil of almond is clear and colorless, or slightly tinged of a greenish yellow, is nearly inodorous, and has a bland, sweetish taste. Its sp. gr. is from 0.914 to 0.920. It consists principally of olein, 70 per cent. It is only slightly soluble in alcohol, but soluble in ether and in chloroform in all proportions. It does not congeal until cooled to near —20° C. (—4° F.). On placing 2 drops of concentrated sulphuric acid upon about 8 drops of the Oil, on a white plate, no dark color should appear at the edge of the acid, and, after stirring, the mixture should not assume a dirty yellow color, retaining its tint for several minutes (difference from most other fixed oils). It is used in making ointment of rose-water, and phosphorated oil.

OLEUM OLIVÆ. *U.S.* Olive Oil.

A fixed oil expressed from the ripe fruit of *Olea europæa* Linné (Nat. Ord. *Oleaceæ*).

Preparation.—Although pure olive oil is still found occasionally, there is good reason to believe that the so-called olive oil is mainly cotton seed oil, or other similar substitution, judiciously flavored. Pure olive oil is made by expressing olives and clarifying the oil by subsidence; but the detection of admixtures of other fixed oils is attended with discouraging results. The exportation of over six million gallons of cotton seed oil annually to Mediterranean ports contiguous to the olive oil industry is a significant fact. The Pharmacopœia furnishes the following tests. It is difficult to detect an admixture of a similar vegetable oil of less than 20 per cent. by any published test.

Oleum Olivæ. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Alcohol.	Other Solvents.
A pale yellow, or light greenish-yellow, oily liquid. When cooled to about 10° C. (50° F.), it begins to be somewhat cloudy from the separation of crystalline particles, and at about 5° C. (41° F.) it begins to deposit a white, granular sediment; below 2° C. (35.6° F.) it forms a whitish, granular mass. Sp. gr. 0.915 to 0.918.	Almost devoid of odor; nutty, oleaginous taste, with a faintly acrid aftertaste; neutral reaction.	Sparingly soluble.	Readily soluble in ether.

Test for Identity.	Impurities.	Test for Impurities.
If 12 parts of the Oil be shaken frequently, during two hours, with 1 part of a freshly prepared solution of 6 Gm. of mercury in 7.5 Gm. of nitric acid (sp. gr. 1.420), a perfectly solid mass of a pale straw color will result.	Appreciable quantities of other Fixed Oils of similar physical properties.	If 1 Gm. of Olive Oil be agitated, in a test-tube, with 2 Gm. of a cold mixture prepared from equal volumes of strong sulphuric acid and of nitric acid of sp. gr. 1.185, and the mixture be set aside for half an hour, the supernatant, oily layer should not have a darker tint than yellowish; nor should a green or red layer separate on standing, if 1 Gm. of the Oil be shaken for a few seconds with 1 Gm. of a cold mixture of sulphuric acid (sp. gr. 1.830) and nitric acid (sp. gr. 1.250) and 1 Gm. of disulphide of carbon; and if 5 drops of the Oil are let fall upon a thin layer of sulphuric acid in a flat-bottomed capsule, no brown-red or dark brown zone should be developed, within three minutes, at the line of contact of the two liquids.

Uses.—Olive oil is used in making cerates, ointments, liniments, and plasters. It is a bland, agreeable oil, well suited for emollient purposes.

OLEUM GOSSYPII SEMINIS. *U.S.* Cotton Seed Oil.

A fixed oil expressed from the seed of *Gossypium herbaceum* Linné, and of other species of *Gossypium* (Nat. Ord. *Malvaceæ*), and subsequently purified.

Preparation.—This oil is made commercially in the southern part of the United States upon a very large scale. The seeds contain 15 per cent. of oil.

The testa of the seeds is first separated, and the kernels are exposed to powerful expression in hydraulic presses.

This is a bright, pale yellow, oily liquid, odorless, having a bland, nut-like taste, and a neutral reaction. Sp. gr. 0.920 to 0.930. It is only slightly soluble in alcohol, but readily so in ether. When cooled to near 2° C. (35.6° F.), it begins to congeal. Concentrated sulphuric acid instantly renders it dark reddish-brown. It is used officinally to form the oily basis for the four liniments of ammonia, lime, camphor, and subacetate of lead.

OLEUM SESAMI. *U.S.* Oil of Sesamum. [Benné Oil.]

A fixed oil expressed from the seed of *Sesamum indicum* Linné (Nat. Ord. *Pedaliaceæ*).

This oil consists of olein (70 per cent.), palmitin, stearin, and myristicin. It is inodorous, of a bland, sweetish taste and a neutral reaction, and will keep long without becoming rancid. It is not a drying oil. At 12.7° C. (55° F.) it has the sp. gr. 0.919; and its point of congelation is —5° C. (23° F.). Sp. gr. 0.914 to 0.923. When cooled to near 5° C. (23° F.), it congeals to a yellowish-white mass. Concentrated sulphuric acid converts it into a brownish-red jelly. If 10 C.c. of the Oil be agitated with 3 drops of a cold mixture of equal volumes of nitric and sulphuric acids, the Oil will acquire a green color, soon changing to brownish red. It bears some resemblance to olive oil in its properties, and may be used for similar purposes.

OLEUM LINI. *U.S.* Oil of Flaxseed. [Linseed Oil.]

A fixed oil expressed from Flaxseed without the use of heat.

Preparation.—It will be noticed that the officinal description specifies an oil made without the use of heat: this would reject all the oil made on the large scale for use in the arts.

Linseed oil is a drying oil, and consists mainly of *linolein*, which, by exposure, becomes *linoxyn*, $C_{32}H_{54}O_{11}$; *myristin* and *palmitin* are also present. It is a yellowish or yellow, oily liquid, having a slight, peculiar odor, a bland taste, and a neutral reaction. When exposed to the air, it gradually thickens, acquires a strong odor and taste, and finally solidifies. Sp. gr. about 0.936. It is soluble in five parts of absolute alcohol and in 1.5 parts of ether. It does not congeal above —20° C. (—4° F.). Linseed oil is used as a laxative, in doses of one to two fluidounces.

PEPO. *U.S.* Pumpkin Seed.

The seed of *Cucurbita Pepo* Linné (Nat. Ord. *Cucurbitaceæ*).

This seed contains about 40 per cent. of fixed oil, starch, protein compounds, a little acrid resin, sugar, etc. Pumpkin seed is used as a tænifuge by beating the kernels with water so as to make a mixture like almond mixture: a more elegant method, however, is to emulsify the fixed oil, which is now an article of commerce, and made by percolating the ground seeds with ether.

OLEUM RICINI. *U.S.* Castor Oil.

A fixed oil expressed from the seed of *Ricinus communis* Linné (Nat. Ord. *Euphorbiaceæ*).

Preparation.—Castor oil has been obtained from the seed in four ways: 1. By cold expression. 2. By expression with heat. 3. By percolation with alcohol. 4. By decoction. The first method produces the best oil: a powerful hydraulic press (see page 224) is generally used, and the oil clarified by subsidence. It is an almost colorless, transparent, viscid liquid, of a faint, mild odor, a bland, afterwards slightly acrid and generally offensive taste, and a neutral reaction. Sp. gr. 0.950 to 0.970. It is soluble in an equal weight of alcohol, and in all proportions in absolute alcohol or in glacial acetic acid. When cooled, it becomes thicker, generally depositing white granules, and at about —18° C. (0.4° F.) it congeals to a yellowish mass. It contains *ricinolein* and palmitin. The purgative action is due to the presence of an acrid principle which has not yet been isolated: a given weight of the seeds is more active than the same quantity of oil. Castor oil is used as a purgative, in doses of one-half to one fluidounce.

OLEUM TIGLII. *U.S.* Croton Oil.

A fixed oil expressed from the seed of *Croton Tiglium* Linné (Nat. Ord. *Euphorbiaceæ*).

Preparation.—Croton oil is prepared by expression or by percolating the ground seeds with bisulphide of carbon and distilling the percolate. It is a pale yellow or brownish-yellow, somewhat viscid and slightly fluorescent liquid, having a slight fatty odor, a mild, oily, afterwards

acrid, burning taste, and a slightly acid reaction. When applied to the skin, it produces rubefaction or a pustular eruption. Sp. gr. 0.940 to 0.955. When fresh, it is soluble in about 60 parts of alcohol, the solubility and therapeutic activity increasing by age. It is freely soluble in ether, chloroform, or disulphide of carbon. Neither the purgative principle nor the vesicating principle has been isolated: by the decomposition of the fatty substances present, tiglinic, valerianic, formic, acetic, myristic, stearic, isobutyric, lauric, and palmitic acids have been detected; crotonol, $C_{18}H_{28}O_4$, is said to be present. Internally, in doses of one minim, croton oil is a powerful purgative; externally, when applied to the skin, it is rubefacient and vesicant.

OLEUM THEOBROMÆ. *U. S.* **Oil of Theobroma.** [BUTTER OF CACAO.]

A fixed oil expressed from the seed of *Theobroma Cacao* Linné (Nat. Ord. *Sterculiaceæ*).

Preparation.—This is made by expressing the kernels of the "chocolate nut" between hot iron plates, and running the product into moulds. The yield is about 40 per cent. It is a yellowish-white solid, having a faint, agreeable odor, a bland, chocolate-like taste, and a neutral reaction. It melts between 30° and 35° C. (86° to 95° F.). If two parts of Oil of Theobroma be dissolved in four parts of ether, in a test-tube, by immersing the tube in water of 17° C. (63° F.), and if this be afterwards plunged into water of 0° C. (32° F.), the mixture should not become turbid, nor separate a granular deposit in less than three minutes; and if the mixture, after congealing, be exposed to a temperature of 15° C. (59° F.), it should gradually become entirely clear.

Chemically, it is a mixture of stearin, palmitin, olein, arachin, and laurin, and, owing to its low fusing-point, and its property of becoming solid at a temperature just above the fusing-point, it is valuable in pharmacy in making suppositories. (See Suppositoria.)

LYCOPODIUM. *U. S.* **Lycopodium.**

The sporules of *Lycopodium clavatum* Linné, and of other species of *Lycopodium* (Nat. Ord. *Lycopodiaceæ*).

Lycopodium contains 47 per cent. of fixed oil, with minute quantities of volatile bases. It is used as a dusting powder and to allay irritation of the skin through chafing, and for similar purposes.

Substances containing Unofficinal Fixed Oils.

Oil of Bassia.	From *Bassia longifolia*. Nat. Ord. Sapotaceæ. A greenish oil is expressed from the seeds.
Bayberry.	From *Myrica cerifera*. Nat. Ord. Myricaceæ. Habitat, North America. The oil and wax are prepared by boiling the fruit with water until the oil collects on the surface. The yield of oil is about 30 per cent.
Beech.	From the fruit of *Fagus sylvatica*. Nat. Ord. Cupuliferæ. Habitat, Europe. It is of a yellow color and mild odor and taste. The yield of oil is about 20 per cent.
Behen.	From the fruit of *Moringa aptera*. Used in ointments and pomades.
Black Mustard.	From the seed of *Sinapis nigra*. Nat. Ord. Siliquosæ. Habitat, Europe. A yellow or brownish-yellow fixed oil. Sp. gr. 0.916. The yield of oil is about 20 per cent.
Brazil Nut.	From the seed of *Bertholletia excelsa*. Nat. Ord. Lecythidaceæ. Habitat, Brazil. It is a pale yellow, bland oil. The yield of oil is about 50 per cent.

Substances containing Unofficinal Fixed Oils.—(*Continued.*)

Oil of Candle Nut.	From *Aleurites triloba*. Habitat, islands of the Pacific Ocean. The yield of oil is about 60 per cent.
Cardamom.	From the fruit of *Elettaria Cardamomum*. Nat. Ord. Zingiberaceæ. The yield of oil is about 10 per cent.
Chaulmugra.	From the seed of *Gynocardia odorata*. Nat. Ord. Bixaceæ. Habitat, Malayan Peninsula. Prepared by subjecting the seeds to pressure and collecting the oil.
Coco-nut.	From *Cocos nucifera*. Nat. Ord. Palmæ. Habitat, tropical countries. Prepared by boiling the seeds with water and expressing. It is of a butyraceous consistence, white, and has a peculiar odor and a bland taste.
Crab.	From *Carapa guianensis*. Prepared by expressing the seed.
Cucumber Seed.	From the seed of *Cucumis sativus*. Nat Ord. Cucurbitaceæ. Habitat, Central Asia.
Ergot.	From *Claviceps purpurea*. The yield of oil is about 25 per cent.
Ground-nut.	From the kernels of the fruit of *Arachis hypogæa*. Prepared by expression.
Hazel-nut.	From *Corylus avellana*. Nat. Ord. Cupuliferæ. Habitat, Europe. The yield of oil is about 50 per cent.
Hemp Seed.	From the seed of *Cannabis sativa*. Nat. Ord. Urticaceæ. Habitat, Europe and North America. The yield of oil is about 30 per cent.
Horsechestnut.	From the kernels of the fruit of *Æsculus Hippocastanum*. Nat. Ord. Sapindaceæ. The yield of oil is about $\frac{1}{10}$ per cent.
Hydrastis.	From *Hydrastis canadensis*. Nat. Ord. Ranunculaceæ. Habitat, United States.
Hyoscyamus Seed.	From the seed of *Hyoscyamus niger*. Nat. Ord. Solanaceæ. Habitat, Europe. The yield of oil is about 25 per cent.
Juglans.	From *Juglans cinerea*. Nat. Ord. Juglandaceæ. Habitat, United States. The yield of oil is about 15 per cent.
Kurung.	From *Pongamia glabra*. Nat. Ord. Leguminosæ. Habitat, India. It is a thickish, yellow oil, of sp. gr. 0.945.
Larkspur Seed.	From the seed of *Delphinium Consolida*. Nat. Ord. Ranunculaceæ. Habitat, Central Europe.
Laurel.	From *Laurus nobilis*. Nat. Ord. Lauraceæ. Habitat, Europe. Prepared by steeping the fruit in hot water and expressing.
Mace.	From the arillus of the fruit of *Myristica fragrans*. Nat. Ord. Myristicaceæ. Habitat, Molucca Islands.
Madia.	From *Madia sativa*. Nat. Ord. Compositæ. Habitat, Europe. The yield of oil is about 40 per cent.
Mangosteen.	From *Garcinia indica*. Nat. Ord. Guttiferæ. Habitat, India. The yield of oil is about 30 per cent.
Melon Seed.	From *Cucumis Melo*. Nat. Ord. Cucurbitaceæ. Habitat, Central Asia.
Nicker Seed	From *Cæsalpinia Bunducella*. Nat. Ord. Leguminosæ.
Nigella.	From the seed of *Nigella sativa*. Nat. Ord. Ranunculaceæ. Habitat, Southern Europe. The yield of oil is about 35 per cent.
Niger Seed	From *Guizotia oleifera*. Nat. Ord. Compositæ. Habitat, India. The yield of oil is about 40 per cent.
Nutmeg.	From the kernel of the seed of *Myristica fragrans*. Nat. Ord. Myristicaceæ. Habitat, Molucca Islands. The yield of oil is about 22 per cent.
Palm.	From the fruit of *Elais guineensis*. Nat. Ord. Palmæ. Habitat, West Africa. Sp. gr. 0.945.
Peach.	From *Persica vulgaris*. Nat. Ord. Rosaceæ. The oil resembles expressed oil of almond.
Poppy Seed.	From the seed of *Papaver somniferum*. Nat. Ord. Papaveraceæ. Habitat, Asia and Europe. It is of a yellow color, bland, and limpid. The yield is about 45 to 50 per cent.
Pumpkin Seed.	From the seed of *Cucurbita Pepo*. Nat. Ord. Cucurbitaceæ. Habitat, Asia and Europe. The yield of oil is about 45 per cent.
Purging Nut.	From the seed of *Curcas purgans*. Nat. Ord. Euphorbiaceæ. Habitat, West Indies. The yield is about 35 per cent.
Rape Seed.	From *Brassica campestris*. A fixed oil used for making green soft soap.
Staphisagria.	From the seed of *Delphinium Staphisagria*. Nat. Ord. Ranunculaceæ. Habitat, Europe. The yield of oil is about 30 per cent.
Stramonium Seed.	From the seed of *Datura Stramonium*. Nat. Ord. Solanaceæ. Habitat, United States. The yield of oil is about 25 per cent.
Tonca.	From the seed of *Dipterix odorata*. Nat. Ord. Leguminosæ. Habitat, Guiana. An odorous fixed oil.
Tucom.	From the fruit of *Astrocaryum vulgare*. Habitat, South America. It has a bright red color and an agreeable odor.
Watermelon Seed.	From the seed of *Cucumis Citrullus*. Nat. Ord. Cucurbitaceæ. Habitat, Southern Asia. The yield is about 30 per cent.
White Mustard.	From the seed of *Sinapis alba*. Nat. Ord. Cruciferæ. Habitat, Asia. The yield of oil is about 20 per cent.

ACIDUM OLEICUM. *U.S.* Oleic Acid.

$HC_{18}H_{33}O_2$; 282.

Preparation.—Oleic acid is generally obtained as a by-product in the manufacture of candles from fats, stearic and palmitic acids being the fatty substances sought for by the makers. The crude oleic acid is known as "red oil," the stearic and palmitic acids being separated by cooling the mixture and filtering.

Acidum Oleicum. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A yellowish, oily liquid, gradually becoming brown, rancid, and acid when exposed to the air. Sp. gr. 0.900 to 0.910.[1] At 14° C. (57.2° F.) it becomes semi-solid, and remains so until cooled to 4° C. (39.2° F.), at which temperature it becomes a whitish mass of crystals.	Odorless, or nearly so; tasteless; when pure, of a neutral reaction.	Insoluble.	Completely soluble.	Completely soluble in chloroform, benzol, benzin, oil of turpentine, and the fixed oils.

Test for Identity.	Impurities.	Tests for Impurities.
At a gentle heat, the Acid is completely saponified by carbonate of potassium. If the resulting soap be dissolved in water and exactly neutralized with acetic acid, the liquid will form a white precipitate with test-solution of acetate of lead.	More than traces of Palmitic and Stearic Acids.	At a gentle heat, the Acid is completely saponified by carbonate of potassium. If the resulting soap be dissolved in water and exactly neutralized with acetic acid, the liquid will form a white precipitate with test-solution of acetate of lead. The above precipitate, after being twice washed with boiling water, should be almost entirely soluble in ether.
	Fixed Oils.	Equal volumes of the Acid and of alcohol, heated to 25° C. (77° F.), should give a clear solution, without separating oily drops upon the surface.

Uses.—Oleic acid is used as the basis for the oleates, two of which—oleate of mercury and oleate of veratrine—are officinal (see page 289). The oleates are very useful external remedies: they are used in various skin diseases, and also for communicating the constitutional effects of numerous remedies. Oleic acid is more quickly absorbed by the skin than any other similar base.

Unofficinal Oleates.

Aluminium Oleate, $Al_2(C_{18}H_{33}O_2)_6$.	By decomposing sodium oleate with aluminium sulphate. It is a semi-solid, of a dark brown color, and has a decidedly astringent action. Used in treating burns, scalds, foul ulcers, etc.
Silver Oleate. $AgC_{18}H_{33}O_2$.	By precipitating sodium oleate with a saturated solution of silver nitrate, washing the precipitate with boiling water, drying it, and reducing to a fine powder. It is of a brownish-yellow color. Used externally.
Arsenic Oleate, $As(C_{18}H_{33}O_2)_3$.	By first preparing arsenious chloride by treating metallic arsenic with hydrochloric acid, and then adding sodium oleate and collecting the precipitate. It is of a yellowish color, and has the consistence of butter.
Bismuth Oleate, $Bi(C_{18}H_{33}O_2)_3$.	By dissolving *crystallized* bismuth nitrate in glycerin, then diluting sodium oleate with water and adding the bismuth solution to the sodium mixture, warming, rejecting the aqueous layer, and, lastly, washing several times with warm water. It is of a white or a yellowish-white color, and has about the consistence of an ointment.

[1] Through an oversight in the U. S. Pharmacopœia the sp. gr. of oleic acid was made 0.800–0.810.

Unofficinal Oleates.—*Continued.*

Copper Oleate, $Cu(C_{18}H_{33}O_2)_2$.	By adding sodium oleate to a saturated solution of copper sulphate, then washing the precipitate. It is a handsome, dark green, waxy solid. Used chiefly in the treatment for ringworm.
Iron Oleate (Ferric), $Fe_2(C_{18}H_{33}O_2)_6$.	By adding sodium oleate to a solution of ferrous sulphate and *boiling*. It is a dark red, soft, solid oleate. Used locally.
Manganese Oleate.	By adding to a solution of sodium oleate a solution of manganese sulphate, heating gently, and collecting the precipitate. It is of a light gray, slightly pinkish color, having a peculiar odor.
Mercury and Morphine Oleate.	By combining with a gentle heat 40 parts mercuric oleate, 3 parts morphine, and 13 parts oleic acid. It forms a very dark brown, soft solid.
Nickel Oleate.	By adding sodium oleate to a solution of nickel sulphate and collecting the precipitate. It is a green, amorphous, waxy substance. Used locally as an astringent.
Lead Oleate, $Pb(C_{18}H_{33}O_2)_2$.	By adding a *clear* solution of lead acetate to a solution of sodium oleate, boiling and washing the precipitate several times. It has the appearance of lead plaster (somewhat lighter in color).
Sodium Oleate.	By dissolving 1 part of pure Castile soap in 8 parts of hot water, cooling, and filtering from deposited sodium palmitate: the filtrate contains sodium oleate.
Tin Oleate.	By adding a solution of tin chloride to a solution of sodium oleate and collecting the precipitate. It has a grayish-yellow color, a soft consistence, and a decided metallic taste.
Zinc Oleate, $Zn(C_{18}H_{33}O_2)_2$.	By adding a solution of sodium oleate to a solution of zinc sulphate, boiling and drying, and reducing the precipitate to an impalpable powder. A pearl-colored powder, with a soft, soapy feel.

GLYCERINUM. *U. S.* Glycerin. [GLYCERINA, Pharm. 1870.]

A liquid obtained by the decomposition of fats or fixed oils, and containing not less than 95 per cent. of absolute Glycerin [$C_3H_5(HO)_3$; 92].

Preparation.—This valuable liquid has been made in several ways. It is usually obtained—1. Through the saponification of fats and oils in making soap or lead plaster. 2. By the decomposition of fats and oils through pressure and superheated steam. Glycerin came into use in medicine and pharmacy about 1846, and it was first obtained on a commercial scale from the washings of lead plaster by Robert Shoemaker, of Philadelphia. In making the plaster, litharge, olive oil, and water are boiled together, when the olein of the oil is decomposed by the lead oxide, according to the following reaction:

$$\underset{\text{Glyceryl Oleate (Olive Oil).}}{2(C_3H_5 3C_{18}H_{33}O_2)} + \underset{\text{Lead Oxide.}}{3PbO} + \underset{\text{Water.}}{3H_2O} = \underset{\text{Lead Oleate (Lead Plaster).}}{3(Pb2C_{18}H_{33}O_2)} + \underset{\text{Glyceryl Hydrate (Glycerin).}}{2(C_3H_5 3HO)}.$$

The plaster, while still hot and in the liquid state, contains glycerin diffused through it. When the liquid plaster is mixed with an equal measure of boiling water, and the mixture stirred briskly, a solution of glycerin is obtained, which, after having been decanted, and evaporated to a limited extent, is freed from lead by hydrosulphuric acid. The liquid is then filtered to separate lead sulphide, heated to free it from hydrosulphuric acid, and finally evaporated to expel the water.

The process most frequently used for making glycerin originated with R. A. Tilghman, of this city, and consists in subjecting fatty bodies to the action of water at a high temperature under pressure, whereby the fats, which are *glycerides* or ethers of the fatty acids, are broken up into glycerin and fatty acids, the water supplying the elements of hydrogen and oxygen necessary for that change. The reaction is as follows in the case of a fat like stearin:

$$\underset{\text{Stearin.}}{C_3H_5 3C_{18}H_{35}O_2} + \underset{\text{Water.}}{3H_2O} = \underset{\text{Glycerin.}}{C_3H_5 3HO} + \underset{\text{Stearic Acid.}}{3HC_{18}H_{35}O_2}.$$

Thus obtained, it is called *distilled glycerin*, and is produced at once in the purest form.

Glycerinum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A clear, colorless liquid, of syrupy consistence, oily to the touch, hygroscopic. Its sp. gr. should not be less than 1.250, corresponding to the presence of at least 95 per cent. of absolute Glycerin.	Odorless; very sweet and slightly warm to the taste; neutral reaction.	In all proportions.	In all proportions.	Soluble in a mixture of 3 parts of alcohol and 1 part of ether; insoluble in ether, chloroform, benzol, or fixed oils.

Tests for Identity.	Impurities.	Tests for Impurities.
In solution with water it is slowly vaporized, with steam, at 100° C. (212° F.); exposed alone to higher temperature, it yields acrid decomposition vapors of a characteristic odor, with a little Glycerin vapor, and at 290° C. (554° F.) it boils and is decomposed. If a fused bead of borax, on a loop of platinum wire, be moistened with Glycerin previously made slightly alkaline with diluted solution of soda, and after a few minutes held in a colorless flame, the latter will be tinted deep green.	Butyric Acid.	Glycerin should be neutral to litmus paper. Upon warming a portion of 5 or 6 Gm. with half its weight of diluted sulphuric acid, no butyric or other acidulous odor should be developed.
	Cane-Sugar.	A portion of 2 or 3 Gm. of Glycerin, gently warmed with an equal volume of sulphuric acid in a test-tube, should not become dark colored.
	Sugars and Dextrin, which leave a porous coal.	A portion of about 2 Gm. of Glycerin, heated in a small, open porcelain or platinum capsule, upon a sand-bath, until it boils, and then ignited, should burn and vaporize so as to leave not more than a dark stain.
	Sugars.	A portion of Glycerin heated to about 85° C. (185° F.), with test-solution of potassio-cupric tartrate, should not give a decided yellowish-brown precipitate, and the same result should be obtained if, before applying this test, another portion be boiled with a little diluted hydrochloric acid for half an hour.
	Metallic Salts.	After full combustion of Glycerin no residue should be left.
	Acrylic, Hydrochloric, Sulphuric, or Oxalic Acid, Iron, or Calcium Salts.	If Glycerin is diluted with 10 times its volume of distilled water, portions should give no precipitates or colors, when treated with test-solution of nitrate of silver, chloride of barium, chloride of calcium, sulphide of ammonium, or oxalate of ammonium.

Chemically, glycerin belongs to the class of alcohols, and is sometimes termed *glycerol*, or *glyceric alcohol*. It is the hydrate of the radical glyceryl C_3H_5, is triatomic, and one, two, or three of the hydrogen atoms may be replaced by monad radicals.

Uses.—Glycerin is one of the most valuable liquids known to pharmacy. It is a solvent and antiseptic, scarcely inferior to alcohol. It is useful in keeping substances moist, owing to its tendency to absorb water from the air. Its agreeable taste and non-poisonous properties adapt it for many purposes. Its varied uses have been constantly referred to in the preceding pages.

SAPO. *U. S.* Soap.

Soap prepared from soda and olive oil.

Preparation.—Soap is made by boiling fats or oils with a solution of caustic alkali until a thick mass is formed. Then, by evaporating the water, or by adding solution of common salt, the soap is separated and caused to rise to the surface: when it has ceased to froth in boiling, it is ladled out into wooden frames to congeal, after which it is cut into bars by means of a wire. The soap, as first separated, is called *grain soap*. It may be purified by dissolving it in an alkaline lye and separating it by common salt. During this process the impurities subside, and the soap combines with more water, and hence becomes weaker, although purer and whiter. Toilet soap is made by *milling* grain soap, or cutting it into small pieces; perfume is then added, thoroughly mixed, and the mixture forced by a plotting-machine through an aperture, which forms it into rolls and cuts it into pieces. These are then moulded into cakes.

The officinal soap is known as Castile soap. The soaps in general use are made from animal fat, chiefly tallow. Soaps are made hard by using a fat containing much stearin, like tallow, and soda for the alkali; they are made soft by using fats containing a large proportion of olein, and potassa for the alkali. When fats and oils undergo *saponification* by reaction with a salifiable base, the olein, palmitin, and stearin present are decomposed into stearic, palmitic, and oleic acids, which unite with the base to form the soap, and into glycerin, which is set free. It has already been stated that stearin is a stearate, palmitin a palmitate, and olein an oleate of glyceryl, C_3H_5, the radical of the triatomic alcohol glycerin, $C_3H_5(OH)_3$, and that the fats and oils are mixtures of these three oily salts. Hence it is obvious that soaps are mixed stearates, palmitates, and oleates of various bases.

Soaps are divided into two classes, soluble and insoluble. The soluble soaps are combinations of the fatty acids with soda, potassa, and ammonia; those which are insoluble consist of the same acids united with earths and metallic oxides. The soluble soaps only are detergent, and to these the name *soap* is usually applied. Several of the insoluble soaps are employed in pharmacy: as, for example, the soap of lead monoxide (litharge), or lead plaster, and the soap of lime, or lime liniment. (See Emplastrum Plumbi and Linimentum Calcis.) The two officinal soaps are of the soluble kind. One is a soda soap, made with olive oil (Castile soap), the other a potassa soap (green soft soap). (See Sapo Viridis.) The soap of ammonia is noticed elsewhere. (See Linimentum Ammoniæ.)

Sapo. *U. S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
A white or whitish solid, hard, yet easily cut when fresh.	Slight, peculiar odor, free from rancidity; disagreeable, alkaline taste; alkaline reaction.	Readily soluble.	Readily soluble.

Impurities.	Tests for Impurities.
An undue amount of Water.	When cut into thin slices and dried to a constant weight at a temperature of 110° C. (230° F.), it should not lose more than 34 per cent. of its weight.
Animal Fat.	A 4 per cent. alcoholic solution of Soap should not gelatinize on cooling.
Carbonate of Sodium.	100 parts of Soap, when dissolved in alcohol, should not leave more than 3 parts of insoluble matter.
Silica and other accidental Impurities.	2 parts of the residue left after dissolving 100 parts of Soap in alcohol, should be soluble in water.
Metals.	The aqueous solution of Soap should remain unaffected on the addition of solution of hydrosulphuric acid.

Uses.—Soap is a laxative and antacid; it is used in pill masses, in combination with resins, to render them soluble and to modify their harsh action. It is also used in liniments, plasters, cerates, etc.

Officinal Preparations.

Emplastrum Saponis . . Made by rubbing 10 parts of powdered soap with water until semi-liquid, and then incorporating with 90 parts of melted lead plaster. (See Emplastra.)
Soap Plaster.

Linimentum Saponis . . Made by digesting 10 parts of soap, in shavings, in 14 parts of water, then dissolving 5 parts of camphor and 1 part of oil of rosemary in 70 parts of alcohol, mixing the solution and filtering, adding enough water to make the whole weigh 100 parts (see page 288). Used externally.
Soap Liniment.

SAPO VIRIDIS. *U.S.* Green Soap.

Soap prepared from potassa and fixed oils.

Preparation.—This is a soft soap, and is generally imported from Germany: it is made from various oils which contain but little stearin.

Sapo Viridis. *U.S.*	Impurities.	Tests for Impurities.
A soft, greenish-yellow, unctuous jelly, having a peculiar odor, which should be free from rancidity, and an alkaline reaction. Soluble in water and in alcohol, without leaving more than a small residue of insoluble matter.	An undue amount of Water.	When dried at 100° C. (212° F.) to a constant weight, Green Soap should not lose more than 40 per cent. of its weight.
	Free Fats.	The residue, after drying Green Soap at 100° C. (212°F.) to a constant weight, should not yield anything to warm benzol.
	Insoluble Carbonates.	The residue left from the alcoholic solution should be almost entirely soluble in water; and the insoluble matter finally remaining should not effervesce with acids.
	Starch.	The residue left from the alcoholic solution should be almost entirely soluble in water; and the insoluble matter finally remaining should not, after being boiled with water and cooled, become blue on the addition of a drop of test-solution of iodine.

Uses.—Green soap is used in skin diseases, chiefly in eczema.

Officinal Preparation.

Tinctura Saponis Viridis . Made by dissolving 65 parts of green soap and 2 parts of oil of lavender in sufficient alcohol to make 100 parts (see page 319). Used externally.
Tincture of Green Soap.

Unsaponifiable Fats and Petroleum Products.

Under this head will be found two officinal products which cannot be classed properly with either the fixed or the volatile oils, yet which in some respects partake of the properties of both. Petrolatum, paraffin, and benzin are products from petroleum, and are hydrocarbons belonging to the marsh-gas series. They have both been introduced into the last edition of the U. S. Pharmacopœia, and have proved to be very useful additions.

PETROLATUM. *U.S.* Petrolatum. [Petroleum Ointment.]

A semi-solid substance, consisting of hydrocarbons, chiefly of the marsh-gas series [$C_{16}H_{34}$; etc.], obtained by distilling off the lighter and more volatile portions from American Petroleum, and purifying the residue. Melting point about 40° C. to 51° C. (104° F. to 125° F.), the first constituting the softer, and the second the firmer variety.

When Petrolatum is prescribed or ordered, without specifying its melting point, the low-melting variety, which liquefies at about 40° C. (104° F.), is to be dispensed.

Preparation.—The "residuums," as they are termed technically, which are obtained in the distillation of petroleum, are purified by first melting and then percolating them through recently burned bone-black: this abstracts the odor and the color. The consistency is varied by mixing them with certain portions of the harder paraffins and stirring them until a homogeneous mixture is made.

Petrolatum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A yellowish or yellow, fat-like mass, transparent in thin layers, more or less fluorescent, especially when melted, completely amorphous. When gently heated until the mass is almost entirely melted, the liquid portion has a sp. gr. varying from 0.835 to 0.860.	Odorless, or giving off, at most, only a faint petroleum odor when heated; tasteless; neutral reaction.	Insoluble.	Scarcely soluble.	Scarcely soluble in cold absolute alcohol, but soluble in 64 parts of boiling absolute alcohol, and readily soluble in ether, chloroform, disulphide of carbon, oil of turpentine, benzin, benzol, and in fixed or volatile oils.

Test for Identity.	Impurities.	Tests for Impurities.
When heated on platinum foil, it is completely volatilized without emitting the acrid vapors of burning fat or resin.	Fixed Oils or Fats of vegetable or animal origin, or Resin.	If 5 Gm. of Petrolatum be digested, for half an hour, with 5 Gm. of soda and 25 Gm. of water, the aqueous layer separated, and supersaturated with diluted sulphuric acid, no oily substance should separate.
	Readily Carbonized Organic Impurities.	Liquefied Petrolatum agitated with sulphuric acid of sp. gr. 1.540 should not acquire a dark color within two hours.

Uses.—Petrolatum is used as a basis for ointments, for which it is well adapted. It is known commercially as *cosmoline, vaseline, petrolina, deodorolina*, etc.

Hard *paraffin*, or paraffin wax, is a solid, white, diaphanous substance resembling white wax, which is made by distilling the residuum obtained from the refiners of petroleum and collecting and purifying the distillate.

Paraffin, in its pure condition, is a white, waxy, inodorous, tasteless substance, harder than tallow, softer than wax, with a specific gravity of 0.877. Its melting point is variable, depending somewhat upon its origin. It ranges between 43° C. and 65° C. (109° F. and 151° F.). It is insoluble in water, is indifferent to the most powerful acids, alkalies, and chlorine, and can be distilled unchanged with strong oil of vitriol. Warm alcohol, ether, oil of turpentine, olive oil, benzol, chloroform, and bisulphide of carbon dissolve it readily. It can be mixed in all proportions with wax, stearin, palmitin, and resin, but it is difficult to prevent the mixtures from "granulating," even after prolonged stirring.

BENZINUM. *U.S.* **Benzin.** [PETROLEUM BENZIN. PETROLEUM ETHER.]

A purified distillate from American Petroleum, consisting of hydrocarbons, chiefly of the marsh-gas series [C_5H_{12}; C_6H_{14}, and homologous compounds], having a sp. gr. from 0.670 to 0.675, and boiling at 50° to 60° C. (122° to 140° F.).

Benzin should be carefully kept in well-stopped bottles or cans, in a cool place, remote from lights or fire.

Benzinum. *U.S.*	Odor and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A transparent, colorless, diffusive liquid. It is highly inflammable, and its vapor, when mixed with air and ignited, explodes violently.	Strong, characteristic odor, slightly resembling that of petroleum, but much less disagreeable; neutral reaction.	Insoluble.	6 parts.	Readily soluble in ether, chloroform, benzol, and fixed and volatile oils.

Test for Identity.	Impurities.	Tests for Impurities.
It should require 6 parts of officinal alcohol to dissolve Benzin (difference from benzol).	Heavy Hydrocarbons.	Benzin, when evaporated upon the hand, should leave no odor, and, when evaporated in a warmed dish, should leave no residue.
	Pyrogenous Products and Sulphur Compounds.	When Benzin is boiled a few minutes with one-fourth its volume of spirit of ammonia and a few drops of test-solution of nitrate of silver, the ammoniacal liquid should not turn brown.
	Benzol.	If 5 drops of Benzin are added to a mixture of 40 drops of sulphuric acid with 10 drops of nitric acid, in a test-tube, the liquid warmed and set aside for half an hour, and then diluted, in a shallow dish, with twice its volume of water, it should not have the bitter-almond-like odor of nitro-benzol.

Uses.—Benzin is a useful solvent for fats, resins, oils, caoutchouc, and similar bodies. It is not identical with benzol, the product obtained in the destructive distillation of coal (see page 662).

CHAPTER LIX.

DRUGS CONTAINING GLUCOSIDES OR NEUTRAL PRINCIPLES, WITH THEIR PREPARATIONS.

GLUCOSIDES are bodies mostly found in plants, yielding glucose, $C_6H_{12}O_6$, as one of their products of decomposition when heated in contact with a diluted mineral acid and water. The other product which is formed at the same time differs in character from the original glucoside. Thus, *Salicin*, if boiled with diluted sulphuric acid, yields dextro-glucose and *saligenin*, or *saligenol*.

$$\underset{\text{Salicin.}}{C_{13}H_{18}O_7} + \underset{\text{Water.}}{H_2O} = \underset{\text{Saligenin.}}{C_7H_8O_2} + \underset{\text{Glucose.}}{C_6H_{12}O_6}.$$

Glucosides may sometimes be split into glucose and the derived product by heating them with baryta water or alkaline solutions, by nitrogenous principles, which act as ferments, like *emulsin* or *synaptase*, or by treatment with yeast ferment or *ptyalin* found in saliva.

Glucosides are sometimes the active principles of the plants in which they are found, but they are more frequently associated with resins, oils, alkaloids, and bitter principles, and for this reason they have not been used to form a separate group for classification in this work: frequent mention, however, will be made of them when the occasion arises, in connection with the drug containing them, and the officinal drugs containing neutral principles have been classed with them.

The following list gives a view of some of the glucosides, with their derivatives:

Glucosides.

GLUCOSIDE.	SOURCE.	DERIVATIVE.
Æsculin, $C_{21}H_{24}O_{13}$.	From *Æsculus Hippocastanum*.	Æsculetin.
Amygdalin, $C_{20}NH_{27}O_{11}$.	From *Amygdalus communis*.	Oil of bitter almond and hydrocyanic acid.
Arbutin, $C_{12}H_{16}O_7$.	From *Uva Ursi* and other Ericaceæ.	Hydrokinone and methylhydrokinone.
Bryonin, $C_{48}H_{80}O_{19}$.	From *Bryonia alba* and *B. dioica*.	Bryoretin and hydrobryoretin.
Colocynthin, $C_{56}H_{84}O_{23}$.	From *Citrullus colocynthis*.	Colocynthein.
Convallamarin, $C_{23}H_{44}O_{13}$.	From *Convallaria majalis*.	Convallamaretin.
Convallarin, $C_{34}H_{62}O_{11}$.	From *Convallaria majalis*.	Convallaretin.
Convolvulin, $C_{31}H_{50}O_{16}$.	From *Exogonium Purga*.	Convolvulinol and convolvulinolic acid.
Crocin, $C_{29}H_{42}O_{15}$.	From *Crocus sativus*.	Crocetin.
Daphnin, $C_{31}H_{34}O_{19}$.	From *Daphne Mezereum*.	Daphnetin.
Datiscin, $C_{21}H_{22}O_{12}$.	From *Datisca cannabina*.	Datiscetin.
Digitalin, $C_{27}H_{45}O_{15}$.	From *Digitalis purpurea*.	Digitaliretin and paradigitaliretin.

Glucosides.—(*Continued.*)

Glucoside.	Source.	Derivative.
Elaterin, $C_{20}H_{28}O_5$.	From *Elaterium.*	
Fraxin, $C_{22}H_{26}O_{20}$.	From *Fraxinus Ornus.*	Fraxetin.
Gentiopicrin, $C_{20}H_{30}O_{12}$.	From *Gentiana lutea.*	Gentiogenin.
Globularin, $C_{30}H_{44}O_{14}$.	From *Globularia Alypum.*	Globularetin.
Glycyrrhizin, $C_{24}H_{36}O_9$.	From *Glycyrrhiza glabra.*	Glycyrretin.
Gratiolin, $C_{30}H_{34}O_7$.	From *Gratiola officinalis.*	Gratioletin and gratiolaretin.
Gratiosolin, $C_{46}H_{84}O_{25}$.	From *Gratiola officinalis.*	Gratiosoletin.
Helecin, $C_{13}H_{16}O_7$.	From Salicin.	Salicyl aldehyd.
Indican.	From Indigo.	Indiglucin.
Jalapin, $C_{68}H_{112}O_{33}$.	From *Exogonium Purga.*	Jalapinol.
Ononin, $C_{30}H_{34}O_{13}$.	From *Ononis spinosa.*	Formonetin.
Phillyrin, $C_{27}H_{34}O_{11}$.	From *Phillyria latifolia.*	Phillygenin.
Phlorizin, $C_{21}H_{24}O_{10}$.	From the bark of the pear, apple, cherry, and plum tree.	Phloretin.
Pinipicrin, $C_{22}H_{36}O_{11}$.	From *Thuja occidentalis.*	Ericinol.
Populin, $C_{20}H_{27}O_8$.	From different species of Populus.	Benzoic acid, saliretin.
Prophetin, $C_{22}H_{26}O_7$.	From *Cucumis prophetarum.*	Propheretin.
Quercitrin, $C_{35}H_{36}O_{20}$.	From *Quercus tinctoria.*	Quercetin.
Quinovin, $C_{30}H_{48}O_8$.	From the bark of Cinchonas.	Quinovic acid.
Salicin, $C_{13}H_{18}O_7$.	From different species of Salix and Populus.	Saligenin.
Santonin, $C_{15}H_{18}O_3$.	From *Artemisia maritima.*	Santoniretin.
Saponin, $C_{32}H_{54}O_{18}$.	From *Saponaria officinalis.*	Saponetin.
Thujin, $C_{20}H_{22}O_{12}$.	From *Thuja occidentalis.*	Thujigenin and thujetin.
Xanthorhamnin, $C_{22}H_{28}O_{14}$.	From *Rhamnus amygdalinus.*	Rhamnetin.

GENTIANA. *U.S.* Gentian.

The root of *Gentiana lutea* Linné (Nat. Ord. *Gentianaceæ*).

Gentian contains the glucoside *gentiopicrin* (which splits, when heated with dilute acids, into gentiogenin and grape-sugar), *gentisic* acid, $C_{14}H_{10}O_5$, pectin, sugar (gentianose), and a little fixed oil. A dark-green coloration is produced when a ferric salt is added to a preparation of gentian: this is said to be due to the reaction with gentisic acid; if the preparation is treated with ferric hydrate, and then filtered, the tendency to become discolored is lost. Gentian is a bitter tonic.

Officinal Preparations.

Extractum Gentianæ Fluidum . Made with a menstruum of diluted alcohol (see page 346).
Fluid Extract of Gentian. Dose, ten to thirty minims.

Extractum Gentianæ . . . . . An aqueous extract made with cold water (see page 382).
Extract of Gentian. Dose, ten to thirty grains.

Tinctura Gentianæ Composita . Made by mixing 8 parts of gentian, 4 parts of bitter orange peel, and 2 parts of cardamom together, and percolating with diluted alcohol to obtain 100 parts (see page 312).
Compound Tincture of Gentian. Dose, one to two fluidrachms.

CALUMBA. *U.S.* Calumba. [Columbo.]

The root of *Jateorrhiza Calumba* Miers (Nat. Ord. *Menispermaceæ*).

This African root owes its virtues to *colombin*, $C_{21}H_{22}O_7$, and *berberine*, both of which are very bitter; starch and colombic acid are present, with a mucilage which is often troublesome by interfering with per-

colating operations. Calumba must not be in very fine powder if it is to be percolated with diluted alcohol. It is a bitter tonic.

Officinal Preparations.

Extractum Calumbæ Fluidum . Fluid Extract of Calumba.	Made with a menstruum of diluted alcohol; the calumba in No. 20 powder (see page 338). Dose, fifteen to thirty minims.
Tinctura Calumbæ . . . . . Tincture of Calumba.	Made by percolating 10 parts of calumba, in No. 20 powder, with sufficient menstruum, consisting of 3 parts of alcohol and 2 parts of water, to make 100 parts (see page 306). Dose, one to two fluidrachms.

QUASSIA. *U. S.* Quassia.

The wood of *Picræna excelsa* Lindley (*Quassia excelsa* Swartz. Nat. Ord. *Simarubaceæ*).

Quassia contains *quassin*, $C_{10}H_{12}O_3$, which is intensely bitter, and soluble in both alcohol and water; there are also present resin, mucilage, etc. It is a bitter tonic.

Officinal Preparations.

Extractum Quassiæ Fluidum . Fluid Extract of Quassia.	Made with diluted alcohol (see page 356). Dose, five to ten minims.
Extractum Quassiæ . . . . . Extract of Quassia.	An aqueous extract, with 5 per cent. of glycerin, made with cold water (see page 387). Dose, one to two grains.
Tinctura Quassiæ . . . . . Tincture of Quassia.	Made by percolating 10 parts of quassia with diluted alcohol to obtain 100 parts (see page 318). Dose, one-half to one fluidrachm.

CHIRATA. *U. S.* Chirata.

Ophelia Chirata Grisebach (Nat. Ord. *Gentianaceæ*).

Chirata contains a bitter glucoside, *chiratin*, $C_{26}H_{48}O_{15}$, and a very bitter principle, ophelic acid, $C_{13}H_{20}O_{10}$. It is used as a tonic and febrifuge.

Officinal Preparations.

Extractum Chiratæ Fluidum . Fluid Extract of Chirata.	Made with a menstruum of diluted alcohol containing 10 per cent. of glycerin (see page 340). Dose, half a fluidrachm.
Tinctura Chiratæ . . . . . Tincture of Chirata.	Made by percolating 10 parts of chirata with sufficient diluted alcohol to make 100 parts (see page 308). Dose, one to two fluidrachms.

CORNUS. *U. S.* Cornus. [Dogwood.]

The bark of the root of *Cornus florida* Linné (Nat. Ord. *Cornaceæ*).

This bark contains *cornin*, a bitter principle, tannin, gum, and resin.

Officinal Preparation.

Extractum Cornus Fluidum . Fluid Extract of Cornus.	Made with a menstruum of diluted alcohol containing 20 per cent. of glycerin (see page 343). Dose, half a fluidrachm.

SALIX. *U. S.* Salix. [Willow.]

The bark of *Salix alba* Linné, and of other species of *Salix* (Nat. Ord. *Salicaceæ*).

Willow bark owes its bitterness to *salicin*, $C_{13}H_{18}O_7$, a glucoside; it also contains tannin. It is considered to be a tonic.

SALICINUM. *U. S.* Salicin.

$C_{13}H_{18}O_7$; 286.

A neutral principle prepared from the bark of *Salix Helix* Linné, and of other species of *Salix* (Nat. Ord. *Salicaceæ*).

Preparation.—A boiling concentrated decoction of the bark is treated with lead oxide until it becomes nearly colorless. Gum, tannin, and extractive matter, which would impede the crystallization of the salicin, are thus removed from the liquid; while a portion of the oxide is dissolved in combination probably with the salicin. To separate this portion of oxide, sulphuric acid is first added, and then barium sulphide, and the liquor is filtered and evaporated. Salicin is deposited, and may be purified by repeated solution and crystallization. It is a glucoside, splitting into saligenin and sugar under the influence of dilute acids and heat.

Salicinum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Colorless or white, silky, shining crystals, permanent in the air. When heated to about 198° C. (388.4° F.), Salicin melts, yielding a colorless liquid, and on ignition it emits vapors having the odor of salicylous acid, and is finally wholly dissipated. If 1 part of Salicin be agitated with 20 parts of water and 5 parts of solution of potassa, a clear, colorless solution is obtained.	Odorless; very bitter taste; neutral reaction.	Cold. 28 parts. Boiling. 0.7 part.	Cold. 30 parts. Boiling. 2 parts.	Insoluble in ether or chloroform.

Tests for Identity.

Cold, concentrated sulphuric acid dissolves it with a red color; the solution, after the addition of water, becomes colorless and deposits a dark red powder insoluble in water or alcohol. The difference from alkaloids is shown by the aqueous solution of Salicin not being precipitated by tannic or picric acid, nor by iodide of mercury and potassium.

Uses.—Salicin is used as a febrifuge, in doses of twenty to thirty grains.

PRINOS. *U.S.* Prinos. [Black Alder.]

The bark of *Prinos verticillatus* Linné (*Ilex verticillata* Gray. Nat. Ord. *Aquifoliaceæ*).

This bark contains a bitter principle, resin, wax, tannin, starch, gum, etc. It is a tonic, astringent, and alterative.

TARAXACUM. *U.S.* Taraxacum. [Dandelion.]

The root of *Taraxacum Dens-leonis* Desfontaines (Nat. Ord. *Compositæ*), gathered in autumn.

Taraxacum owes its bitterness to *taraxacin*, $C_8H_{16}O$, an acrid crystalline principle, soluble in alcohol and water. It also contains pectin, sugar, resin, gum, etc.

Officinal Preparations.

Extractum Taraxaci Fluidum . Made with a menstruum of 2 parts of alcohol and 3 parts of water (see page 363). Dose, one to three fluidrachms.
Fluid Extract of Taraxacum.

Extractum Taraxaci . . . . . An inspissated juice from fresh taraxacum (see page 387). Dose, thirty to sixty grains.
Extract of Taraxacum.

LAPPA. *U. S.* Lappa. [BURDOCK.]

The root of *Lappa officinalis* Allioni (Nat. Ord. *Compositæ*).

Lappa contains a bitter substance, inulin, sugar, mucilage, etc. It is an alterative, tonic, and diaphoretic.

SCILLA. *U. S.* Squill.

The sliced bulb of *Urginea Scilla* Steinheil (Nat. Ord. *Liliaceæ*).

Squill contains the bitter principle *scillipicrin*, *scillitoxin*, *scillin*, and *scillain*, a poisonous glucoside. There are also present a large quantity of mucilage, calcium oxalate, sinistrin, etc. Water and alcohol extract its virtues. It is expectorant, emetic, and diuretic.

Officinal Preparations.

Acetum Scillæ . . . . . Made by percolating 10 parts of ground squill previously macerated in 30 parts of diluted acetic acid with the latter until 100 parts are obtained (see page 370). Dose, fifteen to thirty minims.
Vinegar of Squill.

Extractum Scillæ Fluidum . Made with a menstruum of alcohol, thus avoiding the solution of the squill mucilage (see page 360). Dose, two to three minims.
Fluid Extract of Squill.

Syrupus Scillæ . . . . . Made by dissolving 60 parts of sugar in 40 parts of vinegar of squill (see page 267). Dose, thirty minims.
Syrup of Squill.

Syrupus Scillæ Compositus . Made with 120 parts each of squill and senega, 3 parts of tartrate of antimony and potassium, 1200 parts of sugar; diluted alcohol to percolate the drugs, and precipitated phosphate of calcium to aid in clearing the filtrate (see page 267). Dose, fifteen to thirty minims.
Compound Syrup of Squill.

Tinctura Scillæ . . . . . Made by percolating 15 parts of squill with sufficient diluted alcohol to make 100 parts (see page 319). Dose, ten to twenty minims.
Tincture of Squill.

DIGITALIS. *U. S.* Digitalis. [FOXGLOVE.]

The leaves of *Digitalis purpurea* Linné (Nat. Ord. *Scrophulariaceæ*), collected from plants of the second year's growth.

Digitalis has been the subject of exhaustive investigation. The principle digitalin was at one time considered to be an alkaloid. It is, as usually seen, a mixture of digitoxin and other neutral principles. Digitoxin is converted into *toxiresin* by the action of diluted acids and heat. Digitalis is used as a sedative and cardiac stimulant.

Officinal Preparations.

Abstractum Digitalis . . . . Made by adding an evaporated fluid extract to sugar of milk, so that 1 grain represents 2 grains of digitalis (see page 391). Dose, one grain.
Abstract of Digitalis.

Infusum Digitalis . . . . . Made by pouring 185 parts of boiling water on 3 parts each of digitalis and cinnamon, and, after macerating and straining, adding 15 parts of alcohol (see page 295). Dose, half a fluidounce.
Infusion of Digitalis.

Extractum Digitalis Fluidum . Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 344). Dose, one to two minims.
Fluid Extract of Digitalis.

Extractum Digitalis . . . . . Made with a menstruum of 2 parts of alcohol and 1 part of water, 5 per cent. of glycerin added to extract (see page 381). Dose, half a grain.
Extract of Digitalis.

Tinctura Digitalis . . . . . Made by percolating 15 parts of digitalis with sufficient diluted alcohol to make 100 parts (see page 310). Dose, ten to fifteen minims.
Tincture of Digitalis.

VIOLA TRICOLOR. *U.S.* Viola Tricolor. [PANSY.]

The wild-grown, flowering herb of *Viola tricolor* Linné (Nat. Ord. *Violaceæ*).

This plant yields a bitter principle, resin, salicylic acid, mucilage, sugar, etc. Diluted alcohol extracts its virtues. It is expectorant and alterative, in doses of fifteen to forty grains.

AZEDARACH. *U.S.* Azedarach.

The bark of the root of *Melia Azedarach* Linné (Nat. Ord. *Meliaceæ*).

This bark contains a resinous principle, which is soluble in alcohol, ether, and chloroform. Alcohol is a good menstruum to exhaust it. It is used as an anthelmintic and emetic, in doses of fifteen to thirty grains.

SPIGELIA. *U.S.* Spigelia. [PINKROOT.]

The rhizome and rootlets of *Spigelia marilandica* Linné (Nat. Ord. *Loganiaceæ*).

Spigelia contains a bitter principle, resin, and a trace of volatile oil, with tannin and wax. It is used as an anthelmintic. Alcohol and water extract its virtues.

Officinal Preparation.

Extractum Spigeliæ Fluidum . Made with a menstruum of diluted alcohol (see page 362). Dose, one to two fluidrachms.
Fluid Extract of Spigelia.

BRAYERA. *U.S.* Brayera. [KOOSSO.]

The female inflorescence of *Brayera anthelmintica* Kunth (Nat. Ord. *Rosaceæ*, *Roseæ*.

Brayera contains a bitter resinous principle, kosin, $C_{31}H_{38}O_{10}$, about 24 per cent. of tannin, gum, sugar, etc. It is used as an anthelmintic.

Officinal Preparations.

Infusum Brayeræ . . . . . Made with 6 parts of brayera, in No. 20 powder, with sufficient boiling water to make 100 parts (see page 295). Dose, half a pint (to be taken without straining it).
Infusion of Brayera.

Extractum Brayeræ Fluidum . Made with a menstruum of alcohol (see page 337). Dose, one-half to one fluidounce.
Fluid Extract of Brayera.

SANTONICA. *U.S.* Santonica. [LEVANT WORMSEED.]

The unexpanded flower-heads of *Artemisia maritima*, var. *Stechmanniana* Besser (Nat. Ord. *Compositæ*).

Santonica contains about 2 per cent. of *santonin*, resin, volatile oil, gum, etc. It is used as an anthelmintic. The dose is fifteen to fifty grains.

SANTONINUM. *U.S.* Santonin.

$C_{15}H_{18}O_3$; 246.

A neutral principle prepared from Santonica.
It should be kept in dark, amber-colored vials, and should not be exposed to light.

Preparation.—Santonin may be made by exhausting santonica mixed with lime with diluted alcohol, distilling off the alcohol and adding acetic acid to the residue. The precipitated santonin is purified by dissolving it in alcohol, treating with animal charcoal, and

crystallizing. Santonin forms soluble compounds with alkalies, and it may be precipitated from its solutions by acids. (See Sodii Santoninas, page 491.)

Santoninum. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Colorless, shining, flattened, prismatic crystals, not altered by exposure to air, but turning yellow on exposure to light. The alcoholic and ethereal solutions have an intensely bitter taste. When heated to 170° C. (338° F.), Santonin melts, and forms, if rapidly cooled, an amorphous mass, which instantly crystallizes on coming in contact with a minute quantity of one of its solvents. At a higher temperature it sublimes, partly unchanged, in dense, white, irritating vapors, and is finally wholly dissipated.	Odorless; nearly tasteless when first placed in the mouth, but afterwards bitter; neutral reaction.	Cold. Nearly insoluble. Boiling. 250 parts.	Cold. 40 parts. Boiling. 3 parts.	Soluble in 160 parts of ether, in 4 parts of chloroform, and in solutions of the alkalies.

Tests for Identity.	Impurities.	Test for Impurities.
With alcoholic solution of potassa, Santonin yields a scarlet-red liquid, which gradually becomes colorless. From its solution in alkalies it is completely precipitated by supersaturating with an acid. Its solution in cold, concentrated sulphuric acid is at first colorless, then turns yellow, red, and brown.	Alkaloids.	If water be added, immediately after it is dissolved in sulphuric acid, it is completely precipitated, and the supernatant liquor is not altered upon the addition of test-solution of bichromate of potassium, or of iodide of mercury and potassium.

Uses.—Santonin is used as an anthelmintic, in doses of two grains.

PICROTOXINUM. *U. S.* Picrotoxin.

$C_9H_{10}O_4$; 182.

A neutral principle prepared from the seeds of *Anamirta paniculata* Colebrooke (Nat. Ord. *Menispermaceæ*).

Preparation.—Picrotoxin is made from the kernel of cocculus Indicus by treating an aqueous extract, which has been triturated with magnesia, with hot alcohol; the solution is evaporated, and the crystalline mass purified by recrystallization after decolorizing with animal charcoal.

Picrotoxinum. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Colorless, flexible, shining, prismatic crystals, permanent in the air. When heated to about 200° C. (392° F.), the crystals melt, forming a yellow liquid; when heated on platinum foil, they char and are finally completely dissipated.	Odorless; very bitter taste; neutral reaction.	Cold. 150 parts. Boiling. 25 parts.	Cold. 10 parts. Boiling. 3 parts.	Soluble in acids and in solutions of the alkalies.

TESTS FOR IDENTITY.

Concentrated sulphuric acid dissolves Picrotoxin with a golden-yellow color, which turns violet-red on the addition of a trace of bichromate of potassium. When mixed with three times its weight of nitrate of potassium, moistened with sulphuric acid, and then treated with strong solution of soda in excess, Picrotoxin assumes a brick-red color, of short duration. The aqueous solution should remain unaffected by solutions of salts of mercury or platinum, tannic acid, iodide of mercury and potassium, or other reagents for alkaloids.

Uses.—It has been used as a tonic and antispasmodic, in doses of one-sixtieth of a grain: it is very poisonous in large doses.

ERGOTA. *U.S.* Ergot. [ERGOT OF RYE.]

The sclerotium of *Claviceps purpurea* Tulasne (Nat. Ord. *Fungi*), replacing the grain of *Secale cereale* Linné (Nat. Ord. *Graminaceæ*).

Ergot should be preserved in a dry place, and should not be kept longer than a year.

Ergot owes its activity to *sclerotic acid*, *sclererythrin*, *scleromucin*, *scleroiodin*, and *picrosclerotin*; there is also present *scleroxanthin* and *sclerocrystallin*, with 25 per cent. of fixed oil, mycose, and protein compounds. Diluted alcohol is a good solvent for the active principles. It is used as a parturient and hæmostatic.

Officinal Preparations.

Extractum Ergotæ Fluidum Fluid Extract of Ergot.	Made with a menstruum of 3 parts of alcohol and 4 parts of water; 6 per cent. of diluted hydrochloric acid is added to the weak percolate before evaporating (see page 344). Dose, one-half to four fluidrachms.
Extractum Ergotæ Extract of Ergot.	Made by evaporating 500 parts of fluid extract of ergot to 100 parts (see page 382). Dose, five to twenty grains.
Vinum Ergotæ Wine of Ergot.	Made by percolating 15 parts of ergot with sufficient stronger white wine to make 100 parts (see page 382). Dose, one to four fluidrachms.

USTILAGO. *U.S.* Ustilago. [CORN SMUT.]

Ustilago Maydis Leveillé (Nat. Ord. *Fungi*), grown upon *Zea Mays* Linné (Nat. Ord. *Graminaceæ*).

Ustilago should be preserved in a dry place, and should not be kept longer than a year.

Ustilago contains a principle analogous to sclerotic acid, resin, mucilage, sugar, gum, etc. It is used, like ergot, as a parturient. Diluted alcohol extracts its virtues. Dose, fifteen to thirty grains.

GOSSYPII RADICIS CORTEX. *U.S.* Cotton Root Bark.

The bark of the root of *Gossypium herbaceum* Linné, and of other species of *Gossypium* (Nat. Ord. *Malvaceæ*).

Cotton root bark contains a yellow resin, which becomes red upon exposure to air, fixed oil, tannin, starch, sugar, etc. It is emmenagogue. Dose, sixty grains.

Officinal Preparation.

Extractum Gossypii Radicis Fluidum . Made with alcohol, 65 parts; glycerin, 35 parts; finishing with alcohol (see page 348). Dose, one-half to one fluidrachm.
Fluid Extract of Cotton Root.

CROCUS. *U.S.* Saffron.

The stigmas of *Crocus sativus* Linné (Nat. Ord. *Iridaceæ*).

Saffron contains *polychroit*, $C_{48}H_{60}O_{18}$, a glucoside which splits into *crocin* and glucose, volatile oil, wax, fixed oil, protein compounds, sugar, wax, etc. Saffron is chiefly used as a coloring-substance. It is diaphoretic, anodyne, and carminative. Dose, twenty grains.

Officinal Preparation.

Tinctura Croci . . . . Made by percolating 10 parts of saffron with sufficient diluted alcohol to make 100 parts (see page 310).
Tincture of Saffron.

SANTALUM RUBRUM. *U.S.* Red Saunders.

The wood of *Pterocarpus santalinus* Linné (Nat. Ord. *Leguminosæ*, *Papilionaceæ*).

This wood contains *santalic acid*, a resinous substance, *pterocarpin*, and *santol*. It is used solely as a red coloring. (See Tinctura Lavandulæ Composita.)

RHUS TOXICODENDRON. *U.S.* Rhus Toxicodendron. [Toxicodendron, Pharm. 1870. Poison Ivy.]

The fresh leaves of *Rhus Toxicodendron* Michaux, *Rhus Toxicodendron* and *Rhus radicans* Linné (Nat. Ord. *Terebinthaceæ*, *Anacardieæ*).

These leaves contain *toxicodendric acid*, fixed oil, tannin, mucilage, wax, etc. It is considered to be tonic, irritant, and rubefacient. Dose, five grains.

Drugs containing Saponinoid Principles, with their Preparations.

QUILLAIA. *U.S.* Quillaia. [Soap Bark.]

The bark of *Quillaia Saponaria* Molina (Nat. Ord. *Rosaceæ*, *Roseæ*).

This South American bark owes its action to a peculiar principle, *saponin*, $C_{32}H_{54}O_{18}$, a glucoside, splitting upon heating with dilute acid into *sapogenin* and sugar. Saponin is a sternutatory white powder, soluble in alcohol and hot water; its aqueous solution froths when agitated, like soapsuds; it is found in several other drugs. Quillaia also contains calcium sulphate. It is used principally for cleansing silk. It is sometimes used as a medicine, and is irritant, diuretic, and stimulating.

SARSAPARILLA. *U.S.* Sarsaparilla.

The root of *Smilax officinalis* Kunth, *Smilax medica* Schlechtendal et Chamisso, and of other undetermined species of *Smilax* (Nat. Ord. *Smilaceæ*).

Sarsaparilla contains a glucoside analogous, if not identical, with saponin, termed *parillin*. When boiled with dilute acids, it splits into *parigenin* and grape-sugar. There are also present starch, resin, coloring-matter, and extractive. It is popularly believed to be an alterative. Alcohol and water are good solvents.

Officinal Preparations.

Decoctum Sarsaparillæ Compositum . . . . . Compound Decoction of Sarsaparilla.	Made by boiling 10 parts of sarsaparilla, 2 parts each of sassafras, guaiacum wood, and glycyrrhiza, and 1 part of mezereum, with 100 parts of water (see page 299). Dose, four to six fluidounces.
Extractum Sarsaparillæ Fluidum . . . . . Fluid Extract of Sarsaparilla.	Made with a menstruum composed of 1 part of alcohol and 2 parts of water, with 10 per cent. of glycerin (see page 359). Dose, thirty to sixty minims.
Extractum Sarsaparillæ Compositum Fluidum . Compound Fluid Extract of Sarsaparilla.	Made by mixing 75 parts of sarsaparilla, 12 parts of glycyrrhiza, 10 parts of sassafras, and 3 parts of mezereum together, and percolating with a menstruum of 1 part of alcohol and 2 parts of water, with 10 per cent. of glycerin (see page 359). Dose, thirty to sixty minims.
Syrupus Sarsaparillæ Compositus . . . . . Compound Syrup of Sarsaparilla.	Made by mixing 150 parts of sarsaparilla, 20 parts of guaiacum wood, 12 parts each of pale rose, glycyrrhiza, and senna, 6 parts each of anise, gaultheria, and sassafras, and percolating with diluted alcohol until 600 parts of tincture are obtained. This is evaporated to 300 parts, 100 parts of water are added, the whole filtered, and 600 parts of sugar dissolved in it (see page 266). Dose, four fluidrachms.

SENEGA. *U. S.* Senega.

The root of *Polygala Senega* Linné (Nat. Ord. *Polygalaceæ*).

Senega contains *polygalic acid* (sometimes called *senegin*), fixed oil, pectose, etc. Polygalic acid is analogous to, if not identical with, saponin. Alcohol and water are good menstrua for extracting its virtues. Liquid preparations of senega are very apt to gelatinize, owing to the presence of pectin: this is obviated by using water of ammonia or other alkali to dissolve it. Senega is a valuable expectorant and stimulant. It is used in compound syrup of squill (see page 267).

Officinal Preparations.

Abstractum Senegæ . . . . . Abstract of Senega.	Made by adding an evaporated alcoholic fluid extract to sugar of milk, so that 1 grain represents 2 grains of senega (see page 394). Dose, one to three grains.
Extractum Senegæ Fluidum . Fluid Extract of Senega.	Made with a menstruum of 2 parts of alcohol and 1 part of water, with 2 per cent. of water of ammonia (see page 360). Dose, ten to thirty minims.
Syrupus Senegæ . . . . . Syrup of Senega.	Made with 160 parts of fluid extract of senega, 4 parts of water of ammonia, 600 parts of sugar, and enough water to make 1000 parts (see page 267). Dose, one to two fluidrachms.

CAULOPHYLLUM. *U. S.* Caulophyllum. [Blue Cohosh.]

The rhizome and rootlets of *Caulophyllum thalictroides* Michaux (Nat. Ord. *Berberidaceæ*).

Caulophyllum contains *saponin*, associated with resin, starch, gum, albumen, coloring-matter, extractive, etc. Alcohol is the best menstruum for extracting the virtues of this drug. It is sometimes used as an antispasmodic and emmenagogue.

Unofficinal Drugs containing Glucosides or Bitter Principles.

Chamælirium. Starwort.	The rhizome of *C. luteum* and other species. It contains about 8 per cent. of the glucoside chamælirin.
Convallaria. Lily of the Valley.	The flowers of *C. majalis*, indigenous to Europe and North America. It contains the glucoside convallamarin, $C_{28}H_{44}O_{12}$.
Coriaria. Currier's Sumach.	The leaves of *C. myrtifolia*, grown in Southern Europe. It contains the glucoside coriamyrtin, $C_{30}H_{38}O_{10}$.
Frasera. American Calumba.	The root of *F. Walteri*, indigenous to the United States. It contains gentisic acid and gentiopicrin.
Fraxinus. Ash.	From different species of *Fraxinus*. It contains the bitter glucoside fraxin.
Garcinia. Mangosteen.	Several species of *Garcinia*, grown in tropical countries. It contains mangostin, $C_{30}H_{22}O_8$.
Gillenia. Gillenia.	The rhizome of *G. trifoliata* and others, indigenous to the United States. It contains the bitter principle gillenin, resin, tannin, etc.
Gratiola. Hedge-Hyssop.	From *G. officinalis*, indigenous to Southern Europe. It contains a bitter glucoside, gratiolin, etc.
Helleborus. Black Hellebore.	The rhizome of *H. niger*, grown in Europe. It contains a crystalline glucoside, helleborin, $C_{26}H_{44}O_{15}$.
Ilex. Holly.	The leaves of different species of *Ilex*, indigenous to the United States. It contains ilixanthin, $C_{17}H_{22}O_{11}$, and ilicic acid.
Ledum. Marsh Tea.	The leaves of *L. palustre*, grown in North America. It contains the glucoside ericolin, $C_{34}H_{56}O_{21}$; also about 1 per cent. of volatile oil.
Ligustrum. Privet.	The leaves of *L. vulgare*, indigenous to Southern Europe. It contains ligustrin, etc.
Liriodendron. Tulip-Tree Bark.	The bark of *L. tulipifera*, found in the Northern United States. It contains liriodendrin, which occurs in white prisms.
Lolium. Darnel.	The fruit of *L. temulentum*, found in the United States. It contains loliin, a dingy white powder, etc.
Melilotus. Melilot.	The leaves and flowering branches of *M. officinalis*, indigenous to Europe. It contains coumarin, $C_9H_6O_2$, and melilotic acid, $C_9H_{10}O_3$.
Panax. Ginseng.	The root of *P. quinquefolium*, found in North America. It contains panaquilon, $C_{12}H_{25}O_3$.
Rhamnus Catharticus. Purging Buckthorn.	From *R. catharticus*, found in Europe. It contains rhamnocathartin, which occurs as a yellowish mass, etc.
Ruta. Rue.	The leaves of *R. graveolens*, which grows in Southern Europe. It contains a volatile oil and rutin, $C_{28}H_{28}O_{16}$, which occurs in needle-shaped crystals.
Simaruba. Simaruba.	The bark of the root of *S. officinalis*, grown in South America. It contains a bitter principle, a volatile oil, etc.
Symphytum. Comfrey Root.	The root of *S. officinale*, grown in Europe. It contains asparagin and mucilage.
Taxus. Yew.	From *Taxus baccata*, grown in Asia. It contains volatile oil, taxina, etc.

Drugs containing Cathartic Principles, and their Preparations.

SENNA. *U. S.* Senna.

The leaflets of *Cassia acutifolia* Delile (Alexandria Senna), and of *Cassia elongata* Lémaire-Lisancourt (India Senna); (Nat. Ord. *Leguminosæ*, *Cæsalpiniæ*).

Senna contains cathartic acid, which, under the influence of dilute acids and heat, splits into cathartogenic acid and glucose: there are also present phæoretin, sennocrol, cathartomannit, chrysophan, mucilage, etc. Cathartic acid is believed to be the chief purgative principle, although several of the others possess cathartic properties. When senna leaves are macerated in strong alcohol, the principles which produce griping and give odor and taste are dissolved, whilst the purgative properties are unaffected. Water and diluted alcohol are good solvents for its virtues. The dose of senna is four drachms to one ounce when given in infusion.

Officinal Preparations.

Extractum Sennæ Fluidum (Fluid Extract of Senna.)	Made with a menstruum of 3 parts of alcohol and 4 parts of water (see page 361). Dose, one to four fluidrachms.
Infusum Sennæ Compositum (Compound Infusion of Senna.)	6 parts of senna, 12 parts each of manna and sulphate of magnesium, 2 parts of fennel, and 100 parts of boiling water (see page 296). Dose, four fluidounces.
Syrupus Sennæ (Syrup of Senna.)	Made by digesting 33 parts of senna in 160 parts of water, expressing and straining, repeating with the residue, evaporating the strained liquids to 30 parts, adding 4 parts of alcohol mixed with 1 per cent. of oil of coriander, filtering the mixture, and agitating with 60 parts of sugar (see page 268).
Confectio Sennæ (Confection of Senna.)	Made from 10 parts each of senna and tamarind, 16 parts of cassia fistula, 7 parts of prune, 6 parts of coriander, 12 parts of fig, 50 parts of sugar, and 60 parts of water. (See Confectiones.) Dose, two drachms.

TAMARINDUS. *U.S.* Tamarind.

The preserved pulp of the fruit of *Tamarindus indica* Linné (Nat. Ord. *Leguminosæ*, *Cæsalpinieæ*).

Tamarind belongs to the class of acid saccharine fruits (see page 708) and also to the cathartics. It is laxative, and is used in confection of senna. Copper is sometimes present in the acid pulp, owing to its having been concentrated in copper kettles.

CASSIA FISTULA. *U.S.* Cassia Fistula. [Purging Cassia.]

The fruit of *Cassia Fistula* Linné (Nat. Ord. *Leguminosæ*, *Cæsalpinieæ*).

Cassia fistula yields about 25 per cent. of pulp, which contains pectin, sugar, albuminous principles, salts, etc. The pulp is laxative, and is used in confection of senna.

FICUS. *U.S.* Fig.

The fleshy receptacle of *Ficus Carica* Linné (Nat. Ord. *Urticaceæ*, *Artocarpeæ*), bearing fruit upon its inner surface.

Figs contain mucilaginous constituents, sugar, fat, gum, etc. They are nutritious, demulcent, and laxative, and the pulp is used in confection of senna.

PRUNUM. *U.S.* Prune.

The fruit of *Prunus domestica* Linné (Nat. Ord. *Rosaceæ*, *Amygdaleæ*).

This fruit contains sugar, malic acid, pectin, salts, etc. The pulp is laxative, and is used in confection of senna.

RHEUM. *U.S.* Rhubarb.

The root of *Rheum officinale* Baillon, and of other undetermined species of *Rheum* (Nat. Ord. *Polygonaceæ*).

Rhubarb contains four resins, which are cathartic in their properties,—*erythroretin*, *phæoretin*, *aporetin*, *emodin*. There are also present chrysophan and chrysophanic acid, both yellow, the former yielding the latter and glucose when treated with diluted acids. The astringent properties of rhubarb are due to *rheotannic acid*, $C_{28}H_{26}O_{14}$; *rheumic acid*, $C_{20}H_{16}O_9$, and calcium oxalate are also present. The therapeutical properties of rhubarb depend upon the valuable natural combination of its cathartic and astringent constituents. It is given in doses of ten to twenty grains.

Officinal Preparations.

Extractum Rhei . . . . . Extract of Rhubarb.	Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 387). Dose, five to ten grains.
Extractum Rhei Fluidum . . . . Fluid Extract of Rhubarb.	Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 356). Dose, twenty minims.
Tinctura Rhei . . . . . Tincture of Rhubarb.	Made by percolating 12 parts of rhubarb and 2 parts of cardamom with sufficient diluted alcohol to make 100 parts (see page 318). Dose, one-half to one fluidrachm.
Tinctura Rhei Aromatica . . . . Aromatic Tincture of Rhubarb.	Made by percolating 20 parts of rhubarb, 4 parts each of cinnamon and cloves, and 2 parts of nutmeg, with sufficient diluted alcohol to make 100 parts (see page 318). Dose, one-half to one fluidrachm.
Tinctura Rhei Dulcis . . . . . Sweet Tincture of Rhubarb.	Made by percolating 8 parts of rhubarb, 4 parts each of glycyrrhiza and anise, and 1 part of cardamom, with sufficient diluted alcohol to make 100 parts (see page 319). Dose, two to three fluidrachms.
Syrupus Rhei . . . . . Syrup of Rhubarb.	90 parts of rhubarb, 18 parts of cinnamon, 6 parts of carbonate of potassium, 600 parts of sugar, with water to make 1000 parts (see page 265). Dose, one to four fluidrachms.
Syrupus Rhei Aromaticus . . . Aromatic Syrup of Rhubarb.	Made by adding 10 parts of aromatic tincture of rhubarb to 90 parts of syrup (see page 265).
Vinum Rhei . . . . . Wine of Rhubarb.	Made by percolating 10 parts of rhubarb and 1 part of calamus with sufficient stronger white wine to make 100 parts (see page 325). Dose, one to four fluidrachms.
Mistura Rhei et Sodæ . . . . . Mixture of Rhubarb and Soda.	30 parts each of fluid extract of rhubarb, spirit of peppermint, and bicarbonate of sodium, with water to make 1000 parts (see page 274). Dose, one to eight fluidrachms.
Pulvis Rhei Compositus . . . . Compound Powder of Rhubarb.	25 parts of powdered rhubarb, 65 parts of magnesia, and 10 parts of ginger. (See Pulveres.) Dose, half a drachm to a drachm.
Pilulæ Rhei . . . . . Pills of Rhubarb.	Each pill contains 3 grains of rhubarb and 1 grain of soap.
Pilulæ Rhei Compositæ . . . . Compound Pills of Rhubarb.	Each pill contains 2 grains of rhubarb, 1½ grains of purified aloes, 1 grain of myrrh, and $\frac{1}{10}$ grain of oil of peppermint.

CHRYSAROBINUM. *U. S.* Chrysarobin.

A mixture of proximate principles (commonly misnamed Chrysophanic Acid), extracted from Goa-Powder, a substance found deposited in the wood of the trunk of *Andira Araroba* Aguiar (Nat. Ord. *Leguminosæ*, *Papilionaceæ*).

Chrysarobin is a pale orange-yellow, crystalline powder, permanent in the air, odorless and tasteless, almost insoluble in water, only slightly soluble in alcohol, readily soluble in ether and in boiling benzol. When heated to about 162° C. (323.6° F.), it melts, and may be partially sublimed. On ignition it is wholly dissipated. In solutions of alkalies it is soluble with a reddish-yellow color, which is changed to red by passing air through the liquid. This is due to its conversion into chrysophanic acid.

$$\underset{\text{Chrysarobin.}}{C_{30}H_{26}O_7} + 4O = \underset{\text{Chrysophanic Acid.}}{2C_{15}H_{10}O_4} + \underset{\text{Water.}}{3H_2O}$$
$$\text{Oxygen.}$$

Sulphuric acid dissolves chrysarobin with a deep blood-red color; on pouring the solution into water, the substance separates again unchanged.

Chrysarobin has been largely used in certain skin diseases, notably psoriasis: it has fallen into disuse mainly on account of the almost indelible stain produced upon the skin and clothing when it is employed. Internally, chrysarobin is cathartic.

Officinal Preparation.

Unguentum Chrysarobini . . Chrysarobin Ointment.	Made by rubbing 10 parts of chrysarobin with 90 parts of benzoinated lard. (See Unguenta.)

KAMALA. *U. S.* **Kamala.** [ROTTLERA, Pharm. 1870.]

The glands and hairs from the capsules of *Mallotus philippinensis* Mueller Arg. (Nat. Ord. *Euphorbiaceæ*).

Kamala contains *rottlerin*, $C_{22}H_{20}O_6$, nearly 75 per cent. of resins soluble in alcohol, coloring-matter, etc. It is used as a tænifuge and purgative, and is administered in doses of one to three drachms, suspended in mucilage or syrup.

CAMBOGIA. *U. S.* **Gamboge.** [GAMBOGIA, Pharm. 1870.]

A gum-resin obtained from *Garcinia Hanburii* Hooker filius (Nat. Ord. *Guttiferæ*).

Gamboge contains about 75 per cent. of resin called *gambogic acid*, which is dissolved by alkaline solutions, producing a red color; 20 per cent of gum is present, and this enables gamboge to be emulsified like the other gum-resins. It is a powerful hydragogue cathartic, and is generally used in combination with other substances, which modify its action, as in compound cathartic pills. Dose, one-half to three grains.

JALAPA. *U. S.* **Jalap.**

The tuberous root of *Exogonium Purga* Bentham (Nat. Ord. *Convolvulaceæ*).

Jalap contains from 12 to 20 per cent. of resin, the greater part of which is *convolvulin*, $C_{62}H_{100}O_{32}$, a glucoside insoluble in ether; there are also present gum, sugar, starch, etc. The value of jalap depends exclusively upon the amount of convolvulin present, and the U. S. Pharmacopœia gives the following test of its efficiency: On exhausting 100 parts of Jalap by alcohol, concentrating the tincture, and pouring it into water, a precipitate of resin should be obtained, which, after washing with water, and drying, should weigh not less than 12 parts, and of which not over 10 per cent. should be soluble in ether.

Jalap is an esteemed cathartic, and is generally used in combination with substances having similar properties. Dose, ten to twenty grains.

Officinal Preparations.

Abstractum Jalapæ . . . . Made by adding an evaporated fluid extract to sugar of milk. 1 grain represents 2 grains of jalap (see page 393). Dose, ten grains.
Abstract of Jalap.

Pulvis Jalapæ Compositus . Made by mixing 35 parts of powdered jalap with 65 parts of bitartrate of potassium. Dose, thirty to sixty grains.
Compound Powder of Jalap.

Resina Jalapæ . . . . . Made by exhausting jalap with alcohol, evaporating the tincture, adding it to water, and collecting the precipitated resin (see page 396). Dose, two to five grains.
Resin of Jalap.

SCAMMONIUM. *U. S.* **Scammony.**

A resinous exudation from the root of *Convolvulus Scammonia* Linné (Nat. Ord. *Convolvulaceæ*).

Scammony contains from 80 to 90 per cent. of resin having cathartic properties, called *scammonin*, $C_{34}H_{56}O_{16}$: this is identical with the jalapin obtained from Ipomæa orizabensis (see U. S. Dispensatory, p. 822). Scammony is a hydragogue cathartic: it is usually combined with other purgatives. Dose, ten grains.

Officinal Preparation.

Resina Scammonii . Made by digesting scammony with boiling alcohol, mixing the tinctures, distilling off the alcohol, adding the residue to water, and collecting the precipitate (see page 397). Dose, five grains.
Resin of Scammony.

PODOPHYLLUM. *U.S.* Podophyllum. [May Apple.]

The rhizome and rootlets of *Podophyllum peltatum* Linné (Nat. Ord. *Berberidaceæ*).

Podophyllum contains *picropodophyllin*, *podophyllotoxin*, and *podophyllinic acid*. The resinous substances extracted from the powdered rhizome with alcohol contain the purgative principles. It is cholagogue and cathartic, in doses of ten to twenty grains.

Officinal Preparations.

Abstractum Podophylli . . . . Made by mixing a concentrated fluid extract with dried sugar of milk and powdering (see page 394). Dose, five to ten grains.
Abstract of Podophyllum.

Extractum Podophylli . . . . . Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 386). Dose, one to three grains.
Extract of Podophyllum.

Extractum Podophylli Fluidum . Made with a menstruum of 3 parts of alcohol and 1 part of water (see page 355). Dose, five to fifteen minims.
Fluid Extract of Podophyllum.

Resina Podophylli . . . . . Made by percolating podophyllum with alcohol, distilling the alcohol from the tincture, and pouring the residue into water, cooled to 10° C. (50° F.), containing 1 per cent. of hydrochloric acid (see page 396). Dose, one-eighth to one-half grain.
Resin of Podophyllum.

LEPTANDRA. *U.S.* Leptandra. [Culver's Root.]

The rhizome and rootlets of *Leptandra virginica* Nuttall (*Veronica virginica* Linné.—Nat. Ord. *Scrophulariaceæ*).

Leptandra contains a crystalline principle, *leptandrin*,[1] resin, tannin, saponin, gum, mannit, etc. Crystalline leptandrin is bitter, and soluble in water, alcohol, and ether. Leptandra is cholagogue, cathartic, and alterative, in doses of twenty to forty grains.

Officinal Preparations.

Extractum Leptandræ . . . . . Made with a menstruum of 2 parts of alcohol and 1 part of water; finishing with diluted alcohol; and adding 5 per cent. of glycerin to the finished extract (see page 384). Dose, ten grains.
Extract of Leptandra.

Extractum Leptandræ Fluidum . Made with a menstruum of diluted alcohol with 15 per cent. of glycerin (see page 352).. Dose, twenty minims.
Fluid Extract of Leptandra.

FRANGULA. *U.S.* Frangula.

The bark of *Rhamnus Frangula* Linné (Nat. Ord. *Rhamnaceæ*), collected at least one year before being used.

This bark contains *frangulin*, $C_{20}H_{20}O_{10}$, sometimes called *rhamnoxanthin*, and emodin: both are glucosides. Tannin, resin, and a bitter principle are the other constituents. When frangula is fresh, it is emetic; when old, it is purgative, tonic, and diuretic. The dose is twenty grains.

Officinal Preparation.

Extractum Frangulæ Fluidum . Made with 1 part of alcohol and 2 parts of water (see page 346). Dose, twenty minims.
Fluid Extract of Frangula.

[1] This must not be confounded with the eclectic leptandrin, which is simply a resin extracted by alcohol.

RUMEX. *U.S.* Rumex. [YELLOW DOCK.]

The root of *Rumex crispus* Linné, and of other species of *Rumex* (Nat. Ord. *Polygonaceæ*).

This root contains chrysophanic acid (rumicin, lapathin), mucilage, tannin, starch, calcium oxalate, gum, coloring-matter, etc. Alcohol or water extracts its virtues. It is considered to be tonic, alterative, and astringent. Dose, forty to sixty grains.

Officinal Preparation.

Extractum Rumicis Fluidum . Made with diluted alcohol (see page 358). Dose, one fluidrachm.
Fluid Extract of Rumex.

JUGLANS. *U.S.* Juglans. [BUTTERNUT.]

The inner bark of the root of *Juglans cinerea* Linné (Nat. Ord. *Juglandaceæ*), collected in autumn.

Juglans contains *nucin*, $C_{36}H_{12}O_{10}$, fixed oil, volatile oil, tannin, etc. It is cathartic and tonic, in doses of sixty grains.

Officinal Preparation.

Extractum Juglandis . Made with alcohol: 5 per cent. of glycerin is incorporated with the finished extract (see page 384). Dose, ten grains.
Extract of Juglans.

EUONYMUS. *U.S.* Euonymus. [WAHOO.]

The bark of *Euonymus atropurpureus* Jacquin (Nat. Ord. *Celastraceæ*).

This bark contains resins, a bitter principle called *euonymin*, *euonic acid*, starch, asparagin, and pectin. Euonymin is cholagogue, cathartic, and tonic. The dose of euonymus is sixty grains.

Officinal Preparation.

Extractum Euonymi . Made with diluted alcohol: 5 per cent. of glycerin is incorporated with the finished extract (see page 382). Dose, one to three grains.
Extract of Euonymus.

ALOE. *U.S.* Aloes. [ALOE SOCOTRINA, Pharm. 1870.]

The inspissated juice of the leaves of *Aloe socotrina* Lamarck (Nat. Ord. *Liliaceæ*).

Aloes contains *aloin*, a trace of volatile oil, and a substance which has been improperly called resin. The aloin present in officinal aloes is *socaloin*, $C_{15}H_{16}O_7$. This may be distinguished from nataloin and barbaloin by Histed's test, as follows: Barbaloin and nataloin are colored bright red by nitric acid; socaloin is not colored red. If nataloin be added to a drop of sulphuric acid on a white porcelain plate and a rod dipped in nitric acid be passed over it, the color changes to blue; with the other aloins no blue color is produced. Aloes is cathartic and emmenagogue. Dose, ten to twenty grains.

Officinal Preparations.

Extractum Aloes Aquosum . Made by dissolving aloes in boiling distilled water, cooling, decanting, straining, and evaporating (see page 378). Dose, five to ten grains.
Aqueous Extract of Aloes.

Aloe Purificata . . . . . See next article.
Purified Aloes.

ALOE PURIFICATA. *U.S.* Purified Aloes.

Aloes, 100 parts, or	16 oz. av.
Alcohol, 15 parts, or	3 fl. oz.

Heat the Aloes, by means of a water-bath, until it is completely melted. Then add the Alcohol, and, having stirred the mixture thoroughly, strain it through a fine sieve which has just been dipped into boiling water. Evaporate the strained mixture by means of a water-bath, constantly stirring, until a thread of the mass becomes brittle on cooling. Lastly, break the product, when cold, into pieces of a convenient size, and keep it in well-stopped bottles.

Purified Aloes is in irregular, brittle pieces of a dull brown or reddish-brown color, and having the peculiar aromatic odor of Socotrine Aloes. It is almost entirely soluble in alcohol.

Aloes, owing to its method of preparation, always contains mechanical impurities,—sand, earth, chips, etc. Alcohol reduces the consistency of the melted aloes so that it can be strained, and it is easily evaporated afterwards. Purified aloes is directed to be used in all the officinal preparations of the drug. (See preceding article.)

Officinal Preparations.

Tinctura Aloes (Tincture of Aloes.)	Made by macerating 10 parts each of purified aloes and extract of glycyrrhiza in sufficient diluted alcohol to make 100 parts (see page 304). Dose, two to four fluidrachms.
Tinctura Aloes et Myrrhæ (Tincture of Aloes and Myrrh.)	Made by macerating 10 parts each of purified aloes and myrrh in sufficient alcohol to make 100 parts (see page 304). Dose, one to two fluidrachms.
Vinum Aloes (Wine of Aloes.)	Made by macerating 6 parts of purified aloes and 1 part each of cardamom and ginger in sufficient stronger white wine to make 100 parts (see page 323). Dose, one to four fluidrachms.
Pilulæ Aloes (Pills of Aloes.)	1 pill contains 2 grains each of purified aloes and soap.
Pilulæ Aloes et Asafœtidæ (Pills of Aloes and Asafetida.)	1 pill contains 1½ grains each of purified aloes, asafetida, and soap.
Pilulæ Aloes et Ferri (Pills of Aloes and Iron.)	1 pill contains 1 grain each of purified aloes, dried sulphate of iron, and aromatic powder, with sufficient confection of rose.
Pilulæ Aloes et Mastiches (Pills of Aloes and Mastich.)	1 pill contains 2 grains of purified aloes and ½ grain each of mastic and red rose.
Pilulæ Aloes et Myrrhæ (Pills of Aloes and Myrrh.)	1 pill contains 2 grains of purified aloes, 1 grain of myrrh, and ½ grain of aromatic powder.

COLOCYNTHIS. *U.S.* Colocynth.

The fruit of *Citrullus Colocynthis* Schrader (Nat. Ord. *Cucurbitaceæ*), deprived of its rind.

Colocynth contains *colocynthin*, *colocynthitin*, gum, resin, etc. Colocynthin is a very bitter glucoside, splitting under the action of diluted acids into colocynthein and grape-sugar. The seeds should be rejected. Colocynth is a hydragogue cathartic. Dose, five grains.

Officinal Preparations.

Extractum Colocynthidis (Extract of Colocynth.)	Made by percolating colocynth with diluted alcohol, distilling off the alcohol, and evaporating the residue to dryness (see page 380).
Extractum Colocynthidis Compositum (Compound Extract of Colocynth.)	16 parts of extract of colocynth; 50 parts of aloes; 6 parts of cardamom; 14 parts each of resin of scammony and soap; 10 parts of alcohol (see page 380).

ELATERINUM. *U. S.* Elaterin. $C_{20}H_{28}O_5$; 348.

A neutral principle extracted from Elaterium, a substance deposited by the juice of the fruit of *Ecballium Elaterium* A. Richard (Nat. Ord. *Cucurbitaceæ*).

Preparation.—It may be made by evaporating an alcoholic tincture of elaterium to the consistence of thin oil, and throwing the residue while yet warm into a weak boiling solution of potassa. The potassa holds the green resin in solution, and the elaterin crystallizes as the liquor cools. Or it may be made by exhausting elaterium with chloroform, and adding ether to the solution, which precipitates the elaterin.

Elaterium.—When the fruit of the squirting cucumber is sliced and placed upon a sieve, a perfectly limpid and colorless juice flows out, which soon becomes turbid, and in the course of a few hours begins to deposit a sediment. This, when collected and carefully dried, is very light and pulverulent, of a yellowish-white color, slightly tinged with green, and is called elaterium. The yield is small,—only six grains from forty cucumbers,—but the elaterium is very powerful, one-eighth of a grain purging violently. Commercial elaterium is not usually made in this way, but by expression or other processes, whereby the yield is increased. The elaterium is, of course, weaker.

Elaterinum. *U. S.*	Tests for Identity.
Small, colorless, shining, hexagonal scales or prisms, permanent in the air, odorless, having a bitter, somewhat acrid taste and a neutral reaction. Insoluble in water; soluble in 125 parts of alcohol at 15° C. (59° F.); in 2 parts of boiling alcohol, in 290 parts of ether, and also in solutions of the alkalies, from which it is precipitated by supersaturating with an acid. When heated to 200 C. (392° F.), the crystals turn yellow and melt; on ignition they are wholly dissipated.	A solution of Elaterin in cold, concentrated sulphuric acid assumes a yellow color gradually changing to red. The alcoholic solution of Elaterin should not be precipitated by tannic acid nor by salts of mercury or of platinum.

Elaterin is the purgative principle of elaterium. The dose is one-sixteenth of a grain.

Officinal Preparation.

Trituratio Elaterini . . . 10 parts of elaterin are rubbed up with 90 parts of sugar of milk. Trituration of Elaterin. Dose, one-half grain.

BRYONIA. *U. S.* Bryonia. [Bryony.]

The root of *Bryonia alba*, and of *Bryonia dioica* Linné (Nat. Ord. *Cucurbitaceæ*).

Bryonia contains bryonin, a bitter glucoside soluble in alcohol and in water; starch, sugar, resin, etc. Diluted alcohol extracts its virtues. It is used as a hydragogue cathartic, in doses of twenty grains.

Officinal Preparation.

Tinctura Bryoniæ . . Made by percolating 10 parts of bryonia with sufficient alcohol to Tincture of Bryonia. make 100 parts (see page 306). Dose, one to two fluidrachms.

Drugs containing Astringent Principles, and their Preparations.

GALLA. *U. S.* Nutgall.

Excrescences on *Quercus lusitanica* Webb, var. *infectoria* De Candolle (Nat. Ord. *Cupuliferæ*), caused by the punctures and deposited ova of *Cynips Gallæ tinctoriæ* Olivier (Class, *Insecta*; Order, *Hymenoptera*).

Nutgall contains about 50 per cent. of tannin, 2 per cent. of gallic

acid, sugar, gum, resin, and starch. Nutgall is astringent. Dose, ten to fifteen grains.

Officinal Preparations.

Tinctura Gallæ . . Made by percolating 20 parts of nutgall with diluted alcohol containing 10 per cent. of glycerin to obtain 100 parts (see page 311). Dose, one fluidrachm.
Tincture of Nutgall.

Unguentum Gallæ . Made by rubbing 10 parts of finely-powdered nutgall with 90 parts of benzoinated lard. (See Unguenta.)
Nutgall Ointment.

ACIDUM TANNICUM. *U.S.* Tannic Acid.

$C_{14}H_{10}O_9$ chiefly; 322.

Preparation.—Tannic acid may be made by the modification of Leconnet's method, which was formerly officinal, as follows:

Take of Nutgall, in fine powder, Ether, each, a sufficient quantity. Expose the Nutgall to a damp atmosphere for twenty-four hours, and then mix it with sufficient Ether, previously washed with water, to form a soft paste. Set this aside, covered closely, for six hours; then, having quickly enveloped it in a close canvas cloth, express it powerfully between tinned plates, so as to obtain the liquid portion. Reduce the resulting cake to powder, and mix it with sufficient Ether, shaken with one-sixteenth of its bulk of water, to form again a soft paste, and express as before. Mix the liquids, and allow the mixture to evaporate spontaneously until it assumes a syrupy consistence; then spread it on glass or tinned plates, and dry it quickly in a drying closet. Lastly, remove the dry residue from the plates with a spatula, and keep it in a well-stopped bottle.

The explanation of this process is that water and ether form a soluble compound with tannic acid, which may be separated from the nutgall residue by expression; then, by exposing the thick solution to heat, the ether and water are evaporated, leaving the tannic acid in soft, cellular, friable scales upon the plates. Tannic acid, chemically, is an anhydride of gallic acid, thus shown:

$$\underset{\text{Gallic Acid.}}{2C_7H_6O_5} - \underset{\text{Water.}}{H_2O} = \underset{\text{Tannic Acid.}}{C_{14}H_{10}O_9}.$$

Acidum Tannicum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Light-yellowish scales, permanent in the air.	Faint, peculiar odor; strongly astringent taste; acid reaction.	Cold. 6 parts. Boiling. Very soluble.	Cold. 0.6 part. Boiling. Very soluble.	In 6 parts of glycerin, sparingly in absolute alcohol, freely in diluted alcohol, moderately in washed ether, almost insoluble in absolute ether, chloroform, benzol, and benzin.

Tests for Identity.

When heated on platinum foil, it is completely volatilized. With solution of ferric chloride Tannic Acid forms a bluish-black ink. In aqueous solution it causes precipitates with alkaloids, gelatin, albumen, gelatinized starch, and solution of tartrate of antimony and potassium (distinction from gallic acid).

Uses.—Tannic acid is powerfully astringent, in doses of three to ten

grains. Its solution in glycerin is a valuable liquid form of administration.

Officinal Preparations.

Unguentum Acidi Tannici . Made by rubbing 10 parts of tannic acid with 90 parts of benzoinated lard. (See Unguenta.)
Ointment of Tannic Acid.

Trochisci Acidi Tannici . . Each troche contains one grain of tannic acid. (See Trochisci.)
Troches of Tannic Acid.

ACIDUM GALLICUM. *U. S.* Gallic Acid.

$HC_7H_5O_5.H_2O$; 188.

Preparation.—The former officinal process may be used for making gallic acid: Take of Nutgall, in fine powder, 36 oz.; Purified Animal Charcoal, Distilled Water, each, a sufficient quantity. Mix the Nutgall with sufficient Distilled Water to form a thin paste, and expose the mixture to the air, in a shallow glass or porcelain vessel, in a warm place, for a month, occasionally stirring it with a glass rod, and adding from time to time sufficient Distilled Water to preserve the semi-fluid consistence. Then submit the paste to expression, and, rejecting the expressed liquor, boil the residue in 8 pints of Distilled Water for a few minutes, and filter while hot through Purified Animal Charcoal. Set the liquid aside that crystals may form, and dry them on bibulous paper. If the crystals be not sufficiently free from color, they may be purified by dissolving them in boiling Distilled Water, filtering through a fresh portion of Purified Animal Charcoal, and again crystallizing.

The present accepted view of the relative chemical positions of tannic and gallic acids—*i. e.*, that tannic acid is an anhydride of gallic acid—seems to be practically confirmed by the above process, the tannic acid of the galls being converted into gallic acid through the continued maceration with water.

$$\underset{\text{Tannic Acid.}}{C_{14}H_{10}O_9} + \underset{\text{Water.}}{H_2O} = \underset{\text{Gallic Acid.}}{2C_7H_6O_5}.$$

Acidum Gallicum. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A nearly or quite colorless solid, crystallizing from water in long, silky needles or triclinic prisms, permanent in air. When dried at 100° C. (212° F.), the crystals lose 9.5 to 10 per cent. of combined water. At a low red heat they are completely volatilized.	Odorless; astringent and slightly acidulous taste; acid reaction.	Cold. 100 parts. Boiling. 3 parts.	Cold. 4.5 parts. Boiling. 1 part.	Absolute ether, 39 parts; less soluble in chloroform, benzol, or benzin.

Tests for Identity.

If 5 C.c. of a cold saturated solution of the Acid be treated in a watch-glass with not more than 2 drops of solution of potassa, a deep green color will gradually be developed. This color is changed to purple-red by acids, and is prevented by an excess of alkaline hydrate or carbonate. An aqueous solution of the Acid should not precipitate alkaloids, gelatin, albumen, gelatinized starch, or solution of tartrate of antimony and potassium with chloride of ammonium (distinction from tannic acid).

When gallic acid is sublimed, it is converted by the heat into *pyrogallic acid* and carbon dioxide.

$$\underset{\text{Gallic Acid.}}{C_7H_6O_5} = \underset{\text{Pyrogallic Acid.}}{C_6H_6O_3} + \underset{\text{Carbon Dioxide.}}{CO_2}.$$

Pyrogallic acid is used in the form of ointment in the treatment of psoriasis, although this use is not without danger: it is also employed in photography.

Gallic acid is astringent. Dose, five to fifteen grains.

Officinal Preparation.

Unguentum Acidi Gallici . Made by rubbing 10 parts of gallic acid with 90 parts of benzoinated lard. (See Unguenta.)
Ointment of Gallic Acid.

CATECHU. *U. S.* Catechu.

An extract prepared from the wood of *Acacia Catechu* Willdenow (Nat. Ord. *Leguminosæ*, *Mimoseæ*).

Catechu contains catechu-tannic acid, a peculiar form of tannin, which is insoluble in ether, and turns greenish black with ferric salts. *Catechin* and *catechol* are also present. Owing to the decomposition of the tannic acid, the liquid preparations often gelatinize. It is astringent and tonic. Dose, twenty grains.

Officinal Preparations.

Tinctura Catechu Composita . . Made by percolating 12 parts of catechu and 6 parts of cinnamon with sufficient diluted alcohol to make 100 parts (see page 308). Dose, one to four fluidrachms.
Compound Tincture of Catechu.

Trochisci Catechu . . . . . Each troche contains 1 grain of catechu.
Troches of Catechu.

KINO. *U. S.* Kino.

The inspissated juice of *Pterocarpus marsupium* Roxburgh (Nat. Ord. *Leguminosæ*, *Papilionaceæ*).

Kino contains kino-tannic acid, pyrocatechin, kino red, kinoin, gum, etc. Owing to the decomposition of the kino-tannic acid, the liquid preparations frequently gelatinize. Kino is astringent and tonic. Dose, twenty grains.

Officinal Preparation.

Tinctura Kino . . . Made by dissolving 10 parts of kino in a mixture of 60 parts of alcohol and 15 parts each of glycerin and water, filtering and washing the residue with enough of a mixture of 4 parts of alcohol and 1 part of water to make 100 parts of tincture (see page 314). Dose, one fluidrachm.
Tincture of Kino.

HÆMATOXYLON. *U. S.* Hæmatoxylon. [Logwood.]

The heart-wood of *Hæmatoxylon campechianum* Linné (Nat. Ord. *Leguminosæ*, *Papilionaceæ*).

Logwood contains *hæmatoxylin*, $C_{16}H_{14}O_6$, a colorless, sweet principle, which is reddened upon exposure to light, and turned blackish purple upon contact with alkalies, yielding *hæmatëin*, $C_{16}H_{12}O_6.H_2O$; it also contains tannin, resin, etc. Logwood is astringent. Dose, forty grains. It is used largely in the arts for dyeing.

Officinal Preparation.

Extractum Hæmatoxyli . An aqueous extract made by evaporating the decoction (see page 383). Dose, twenty grains.
Extract of Hæmatoxylon.

KRAMERIA. *U. S.* Krameria. [Rhatany.]

The root of *Krameria triandra* Ruiz et Pavon, and of *Krameria tomentosa* St. Hilaire (Nat. Ord. *Polygalaceæ*, *Krameriæ*).

Krameria contains about 18 per cent. of kramero-tannic acid, starch,

gum, rhatannic red, etc. It is a valuable astringent. Dose, twenty grains.

Officinal Preparations.

Extractum Krameriæ . . . . . An aqueous extract made with cold water (see page 384). Dose, fifteen grains. Used in making Trochisci Krameriæ. (See Trochisci.)
Extract of Krameria.

Extractum Krameriæ Fluidum . Made with diluted alcohol containing 20 per cent. of glycerin (see page 351). Dose, thirty minims. Used in making Syrupus Krameriæ (see page 264).
Fluid Extract of Krameria.

Tinctura Krameriæ . . . . . Made by percolating 20 parts of krameria with sufficient diluted alcohol to make 100 parts (see page 314). Dose, two fluidrachms.
Tincture of Krameria.

QUERCUS ALBA. *U. S.* White Oak.

The bark of *Quercus alba* Linné (Nat. Ord. *Cupuliferæ*).

White oak is largely used in tanning leather: it contains about 10 per cent. of tannic acid, with pectin, resin, and brownish-red coloring-matter. It is astringent. Dose, thirty grains.

ROSA GALLICA. *U. S.* Red Rose.

The petals of *Rosa gallica* Linné (Nat. Ord. *Rosaceæ*, *Roseæ*), collected before expanding.

Red rose contains *quercitrin* and *quercitannic acid:* the pale red coloring-matter is made bright red by the addition of sulphuric acid. It is slightly astringent and tonic. The infusion of red rose is an elegant vehicle for many substances. (See Part VI.)

Officinal Preparations.

Extractum Rosæ Fluidum . Made with diluted alcohol containing 10 per cent. of glycerin (see page 357). Dose, one fluidrachm. Used to make syrup of rose (see page 266).
Fluid Extract of Rose.

Mel Rosæ . . . . . Made by mixing a concentrated hydro-alcoholic fluid extract with honey (see page 269). Used as a flavor.
Honey of Rose.

Confectio Rosæ . . . . . 8 parts of red rose, 64 parts of sugar, 12 parts of clarified honey, and 16 parts of rose-water. Used as an excipient.
Confection of Rose.

ROSA CENTIFOLIA. *U. S.* Pale Rose.

The petals of *Rosa centifolia* Linné (Nat. Ord. *Rosaceæ*, *Roseæ*).

Pale rose petals contain a little tannin, volatile oil, sugar, mucilage, etc. They are used principally on account of their flavor.

Officinal Preparation.

Aqua Rosæ . Made by distilling 40 parts of fresh pale rose with 200 parts of water to obtain 100 parts (see page 251). Used as a vehicle.
Rose-water.

OLEUM ROSÆ. *U. S.* Oil of Rose.

A volatile oil distilled from the fresh flowers of *Rosa damascena* Miller (Nat. Ord. *Rosaceæ*, *Roseæ*).

It is a pale-yellowish, transparent liquid, having a strong odor of rose, a sweetish, rather mild taste, and a slightly acid reaction. Sp. gr. about 0.860. It is but slightly soluble in alcohol. When slowly cooled to near 10° C. (50° F.), the Oil becomes a transparent solid, interspersed with numerous slender, shining, iridescent, scale-like crys-

tals. When rapidly cooled to 12.5° C. (54.5° F.), it congeals to a solid mass of light, feathery, shining scales or plates. Otto of rose, as it is frequently called, is used chiefly as a perfume or flavor.

RHUS GLABRA. *U.S.* Rhus Glabra.

The fruit of *Rhus glabra* Linné (Nat. Ord. *Terebinthaceæ*, *Anacardieæ*). (See page 708).

RUBUS. *U.S.* Rubus. [BLACKBERRY.]

The bark of the root of *Rubus villosus* Aiton, *Rubus canadensis* Linné, and *Rubus trivialis* Michaux (Nat. Ord. *Rosaceæ*, *Dryadeæ*).

Rubus owes its astringent properties to tannic acid: there are also present gum, coloring-matter, etc. The dose is twenty grains.

Officinal Preparation.

Extractum Rubi Fluidum . Made with a menstruum consisting of 9 parts of alcohol, 7 parts of water, and 4 parts of glycerin (see page 357). Dose, a fluidrachm. Used in making Syrupus Rubi (see page 266.)
Fluid Extract of Rubus.

GERANIUM. *U.S.* Geranium. [CRANESBILL.]

The rhizome of *Geranium maculatum* Linné (Nat. Ord. *Geraniaceæ*).

Geranium contains about 15 per cent. of tannic acid, with brownish-red coloring-matter, starch, sugar, pectin, etc. It is astringent and tonic. Dose, thirty grains.

Officinal Preparation.

Extractum Geranii Fluidum . Made with diluted alcohol containing 10 per cent. of glycerin (see page 347). Dose, a fluidrachm.
Fluid Extract of Geranium.

HAMAMELIS. *U.S.* Hamamelis. [WITCHHAZEL.]

The leaves of *Hamamelis virginica* Linné (Nat. Ord. *Hamamelaceæ*), collected in autumn.

Hamamelis contains tannic acid, chlorophyll, bitter principle, mucilage, etc. It is astringent, slightly hæmostatic, and sedative. Dose, sixty grains.

Officinal Preparation.

Extractum Hamamelidis Fluidum . Made with 1 part of alcohol and 2 parts of water (see page 349). Dose, a fluidrachm.
Fluid Extract of Hamamelis.

CHIMAPHILA. *U.S.* Chimaphila. [PIPSISSEWA.]

The leaves of *Chimaphila umbellata* Nuttall (Nat. Ord. *Ericaceæ*).

Chimaphila contains about 5 per cent. of tannic acid, with *chimaphilin*, *ericolin*, *arbutin*, *urson*, sugar, gum, etc. It is used as an astringent, diuretic, and tonic, in doses of thirty grains.

Officinal Preparation.

Extractum Chimaphilæ Fluidum . Made with diluted alcohol containing 10 per cent. of glycerin (see page 340). Dose, a fluidrachm.
Fluid Extract of Chimaphila.

UVA URSI. *U.S.* Uva Ursi. [BEARBERRY.]

The leaves of *Arctostaphylos Uva-ursi* Sprengel (Nat. Ord. *Ericaceæ*).

Uva ursi contains about 6 per cent. of tannic acid, with gallic acid, *urson*, *arbutin*, *ericolin*, gum, resin, coloring-matter, etc. It is used as a diuretic, astringent, and tonic. Dose, thirty grains.

Officinal Preparation.

Extractum Uvæ Ursi Fluidum . Made with diluted alcohol containing 10 per cent. of glycerin (see page 363). Dose, one fluidrachm.
Fluid Extract of Uva Ursi.

CASTANEA. *U.S.* Castanea. [CHESTNUT.]

The leaves of *Castanea vesca* Linné (Nat. Ord. *Cupuliferæ*), collected in September or October, while still green.

Chestnut leaves contain tannic acid, mucilage, etc. They are astringent, tonic, and slightly sedative. Dose, thirty grains.

Officinal Preparation.

Extractum Castaneæ Fluidum . Made with boiling water and alcohol (see page 339). Dose, two fluidrachms.
Fluid Extract of Castanea.

SALVIA. *U.S.* Salvia. [SAGE.]

The leaves of *Salvia officinalis* Linné (Nat. Ord. *Labiatæ*). (See page 720.)

Unofficinal Astringent Substances.

Agrimonia. Agrimony.	From *A. Eupatoria*, grown in North America. It contains tannin and bitter principle.
Bistorta. Bistort.	The rhizome of *Polygonum B.*, grown in Canada and the United States. It contains about 20 per cent. of tannin, etc.
Catechu Pallidum. Gambir.	From *Uncaria Gambir*, grown in the East India Islands. It contains catechin, catechutannin, etc.
Comptonia. Sweet Fern.	The leaves of *C. asplenifolia*, found in North America. It contains volatile oil, tannin, etc.
Diospyros. Persimmon.	The bark of *D. virginiana*, grown in the United States. It contains tannin and malic acid.
Epigæa. Trailing Arbutus.	From *E. repens*, found in North America. It contains tannin, and the principles common to the Ericaceæ.
Epilobium. Willow Herb.	From *E. angustifolium*, found in the Northern Hemisphere. It contains tannin, mucilage, etc.
Epiphegus. Beech-drop.	From *E. virginiana*, a parasitic plant found in North America. It contains tannin, bitter principle, etc.
Hepatica. Liverwort.	The leaves of *H. triloba*, found in North America. It contains tannin, mucilage, etc.
Heuchera. Alum-root.	The root of *H. americana*, found in the United States. It contains about 20 per cent. of tannin.
Hieraceum. Hawkweed.	From different species of *Hieraceum*, found in North America. It contains tannin.
Hippocastanum. Horsechestnut Bark.	The bark of *Æsculus Hippocastanum*, grown in North America. It contains tannin and various other principles.
Ilex Paraguayensis. Maté, Paraguay Tea.	The leaves of *I. paraguayensis*, grown in Brazil. It contains 10 to 15 per cent. of caffeine, etc.
Monesia. Monesia.	From *Chrysophyllum glycyphlæum*, found in Brazil.
Myrobalanus. Myrobalans.	From different species of *Terminalia*, grown in Southern Asia. It contains about 45 per cent. of gallo-tannic acid.
Nymphæa. Water-Lily.	The rhizome of *N. odorata*, found in the United States. It contains tannin and mucilage.
Potentilla. Cinquefoil.	From *P. canadensis*, found in North America. It contains tannin.
Pulmonaria. Lungwort.	From *P. officinalis*, grown in Europe. It contains tannin.
Quercus Tinctoria. Black Oak Bark.	From *Q. coccinea*, var. *tinctoria*, grown in the United States. It contains tannin, etc.
Rhus Aromatica. Sweet Sumach.	From *R. aromatica*. It contains tannin, coloring-matter, gum-resin, etc.
Spiræa. Hardhack.	From *S. tomentosa*, found in North America. It contains tannin and bitter principle.
Statice. Marsh Rosemary.	The root of *S. Limonium*, grown in Europe. It contains tannin and volatile oil.
Tormentilla. Tormentil.	From *T. erecta*, grown in Europe. It contains about 20 per cent. of tannin.

CHAPTER LX.

ALKALOIDS.

THE alkaloids are unquestionably the most important of all the organic compounds which are of interest to the pharmacist, the most active and potent remedies that he dispenses belonging to this class of principles.

Chemically, alkaloids are either *amides* or *amines*. If the former, they are composed of carbon, hydrogen, nitrogen, and oxygen; if the latter, the oxygen is wanting. Alkaloids are obtained from both the vegetable and the animal kingdom. They are found in nearly all the organs of plants, in roots, barks, stems, leaves, petals, seeds, etc. The distinctive features of alkaloids are as follows:

1. They all contain nitrogen. The non-volatile alkaloids (amides) are solids, the volatile alkaloids (amines) are liquids.

2. Alkaloids restore the color of reddened litmus. They combine with acids to form salts, and they are precipitated from their saline solutions upon the addition of alkalies.

3. They are generally the active principles of the plants in which they reside, and are mostly very poisonous or energetic remedies, having a bitter, acrid, or pungent taste.

4. They are mostly crystallizable and colorless, and are insoluble in water, but are soluble in alcohol, chloroform, benzin, benzol, and some in ether. Their salts, on the other hand, are mostly soluble in water, less so in alcohol, but insoluble in chloroform, ether, benzin, and benzol.

5. Alkaloids are mostly precipitated by one or more of the following reagents: potassio-mercuric iodide, auric chloride, tannic acid, phosphomolybdic acid, and picric acid.

The nomenclature adopted for alkaloids requires that the last syllable shall terminate in *ine:* thus, quinine, morphine, strychnine. The Latin termination is *ina:* as, quinina, morphina, etc. The names of neutral principles and glucosides end in *in:* as, salicin, santonin, gelatin.

OPIUM. *U. S.* Opium.

The concrete, milky exudation, obtained in Asia Minor by incising the unripe capsules of *Papaver somniferum* Linné (Nat. Ord. *Papaveraceæ*).

On exhausting 100 parts of Opium, previously dried at a temperature of 105° C. (221° F.), with cold water, and evaporating the solution to dryness, an extract is obtained which should weigh between 55 and 60 parts. Opium, in its normal, moist condition, should yield not less than 9 per cent. of morphine when assayed. (See process, p. 801.)

OPII PULVIS. *U.S.* Powdered Opium.

Opium dried at a temperature not exceeding 85° C. (185° F.), and reduced to a moderately fine (No. 50) powder. Powdered Opium, for pharmaceutical or medicinal uses, should contain not less than 12 nor more than 16 per cent. of morphine, when assayed by the process given below. Any Powdered Opium of a higher percentage may be brought within these limits by admixture with Powdered Opium of a lower percentage, in proper proportions.

Morphiometric Assay.—The proportion of morphine which any particular specimen of opium will furnish may be considered as the best test of its value, except that of an actual trial upon the system. The following is the officinal process for assaying it:

Opium, in any condition to be valued	7 grammes.
Lime, freshly slaked	3 grammes.
Chloride of Ammonium	3 grammes.
Alcohol,	
Stronger Ether,	
Distilled Water, each, a sufficient quantity.	

Triturate together the Opium, Lime, and 20 C.c. of Distilled Water, in a mortar, until a uniform mixture results; then add 50 C.c. of Distilled Water, and stir occasionally, during half an hour. Filter the mixture through a plaited filter, three to three and one-half inches (75 to 90 mm.) in diameter, into a wide-mouthed bottle or stoppered flask (having the capacity of about 120 C.c. and marked at exactly 50 C.c.), until the filtrate reaches this mark. To the filtered liquid (representing 5 grammes of opium) add 5 C.c. of Alcohol and 25 C.c. of Stronger Ether, and shake the mixture; then add the Chloride of Ammonium, shake well and frequently during half an hour, and set it aside for twelve hours. Counterbalance two small filters, place one within the other in a small funnel, and decant the ethereal layer as completely as practicable upon the filter. Add 10 C.c. of Stronger Ether to the contents of the bottle and rotate it; again decant the ethereal layer upon the filter, and afterwards wash the latter with 5 C.c. of Stronger Ether, added slowly and in portions. Now let the filter dry in the air, and pour upon it the liquid in the bottle, in portions, in such a way as to transfer the greater portion of the crystals to the filter. Wash the bottle, and transfer the remaining crystals to the filter, with several small portions of Distilled Water, using not much more than 10 C.c. in all, and distributing the portions evenly upon the filter. Allow the filter to drain, and dry it, first by pressing it between sheets of bibulous paper, and afterwards at a temperature between 55° and 60° C. (131° to 140° F.). Weigh the crystals in the inner filter, counterbalancing by the outer filter. The weight of the crystals in grammes, multiplied by *twenty*, equals the percentage of morphine in the Opium taken.

OPIUM DENARCOTISATUM. *U.S.* Denarcotized Opium.

Powdered Opium, containing 14 per cent. of morphine, 100 parts, or	1 oz. av.
Stronger Ether, 1000 parts, or	14 fl. oz.
Sugar of Milk, in fine powder, a sufficient quantity,	
To make 100 parts, or	1 oz. av.

Macerate the Powdered Opium with *five hundred parts* [or 7 fl. oz.] of Stronger Ether, in a well-closed flask, for twenty-four hours, agitating from time to time. Pour off the clear, ethereal solution, and repeat the maceration with two other portions of the Ether, each of *two hundred and fifty parts* [or 3½ fl. oz.], first for twelve hours, and the last time for two hours. Collect the residue in a weighed dish, dry it, first by a very gentle heat, and, finally, at a temperature not above 85° C. (185° F.), and mix it thoroughly, by trituration, with enough Sugar of Milk to make the product weigh *one hundred parts* [or

1 oz. av.]. Instead of taking *one hundred parts* of Powdered Opium containing *fourteen per cent.* of morphine, a proportionately smaller quantity of Powdered Opium of any higher percentage of morphine may be taken. The proper quantity, in parts by weight, for the above formula, is ascertained by dividing 1400 by the percentage of morphine in the Powdered Opium selected.

Denarcotized Opium, when assayed by the process given on page 801, should yield 14 per cent. of morphine.

Opium owes its value to the narcotic alkaloids present in it. Nineteen alkaloids have been proved to exist in various kinds of opium, and several more have been announced, but their existence has not been certainly confirmed. Two acids are found in opium combined with the alkaloids,—*i.e.*, meconic and lactic acids; there are also present *meconin*, $C_{10}H_{10}O_4$, *meconoiosin*, $C_8H_{10}O_2$, both neutral principles, pectin, glucose, mucilage, caoutchouc, wax, and odorous, fatty, and coloring matters. *Meconic acid* is colored red by ferric salts, the color not being discharged by solution of mercuric chloride. A solution of potassium sulphocyanide is colored in a similar manner, but it is rendered colorless by solution of mercuric chloride. The alkaloids are as follows:

Morphine, $C_{17}H_{19}NO_3.H_2O$. The chief principle, and the first alkaloid discovered (see separate article, page 804).

Codeine, $C_{18}H_{21}NO_3$. An important narcotic alkaloid (see page 804).

Narcotine, $C_{22}H_{23}NO_7$. An alkaloid discovered and named by Derosne in 1803, and erroneously supposed to be the narcotic principle. It is white, tasteless, and inodorous, and crystallizes in silky flexible needles, usually larger than the crystals of morphine, fusible at 115.5° C. (240° F.) and volatilizable at 154.4° C. (310° F.), insoluble in cold water, soluble in 400 parts of boiling water, in 100 parts of cold alcohol, and in 24 parts of boiling alcohol, which deposits it upon cooling, and very soluble in ether. It is colored red by a mixture of sulphuric and nitric acids. It is *not narcotic*, but is said to be antiperiodic.

Thebaine (Paramorphine), $C_{19}H_{21}NO_3$, is white, crystallizable, of an acrid and styptic rather than bitter taste, fusible at about 98.8° C. (210° F.) and volatilizable at 160° C. (320° F.), scarcely soluble in water, very soluble in alcohol and ether when cold, and still more so when heated. Alkalies precipitate it from its acid solutions, and, unless in very concentrated solution, do not dissolve it when added in excess. Unlike morphine, it is not reddened by nitric acid, nor does it become blue with solutions of ferric salts. It is colored red by a mixture of sulphuric and nitric acids. It is not narcotic, but in its effects on the system is closely analogous to strychnine, producing tetanic spasms in the dose of a grain.

Papaverine, $C_{21}H_{21}NO_4$, is crystallizable in needles, fusible at 98.8° C. (210° F.) and volatilizable at 154.4° C. (310° F.). It is insoluble in water, very sparingly soluble in cold alcohol or ether, more soluble in these liquids boiling hot, and deposited by them on cooling, soluble in benzol and chloroform. It is colored dark blue by sulphuric acid, changing to green if a crystal of potassium nitrate be added to it. It is narcotic.

Narceine, $C_{23}H_{29}NO_9$, is in white, silky crystals, inodorous, of a bitter

taste, fusible at 76.6° C. (170° F.) and volatilizable at 215.5° C. (420° F.), soluble in 375 parts of cold and 220 of boiling water, soluble also in alcohol, and insoluble in ether. It forms a bluish compound with a little iodine, the color of which is destroyed by heat and the alkalies. It is rendered blue by the action of mineral acids so far diluted as not to decompose it; but, unlike morphine, it does not become blue by the action of ferric salts, nor red by that of nitric acid. Narceine is narcotic, and may be given in doses of one-third to one-half of a grain.

Hydrocotarnine, $C_{12}H_{15}NO_3$, is soluble in alcohol, acetone, chloroform, benzin, and ether. It melts at 50° C. (122° F.), and loses at a somewhat greater heat the molecule of water with which it crystallizes. Sulphuric acid dissolves it, coloring it yellow in the cold, and crimson-red if heated. Nitric acid colors it yellow; ferric chloride does not affect its color.

Pseudomorphine, $C_{17}H_{19}NO_4$, possesses two properties of morphine: it dissolves in concentrated nitric acid with an intense orange-red, and in solution of ferric chloride with a blue color.

Cryptopine, $C_{21}H_{23}NO_5$, produces a blue color with sulphuric acid; it is but slightly soluble in water or alcohol. It is narcotic.

Protopine, $C_{20}H_{19}NO_5$, is insoluble in water, soluble in alcohol and chloroform.

Laudanine, $C_{20}H_{25}NO_4$. Colored red by sulphuric acid, a reddish-violet when heated.

Codamine, $C_{20}H_{25}NO_4$. Isomeric with laudanine; colored green with nitric acid and ferric chloride.

Rhœadine, $C_{21}H_{21}NO_6$. Nearly insoluble in water, alcohol, ether, benzin, and chloroform; with sulphuric acid it turns a purple color.

Meconidine, $C_{21}H_{23}NO_4$. Amorphous; easily soluble in alcohol, ether, benzol, and chloroform; colored olive-green by sulphuric acid, orange-red by nitric acid.

Laudanosine, $C_{21}H_{27}NO_4$. Produces rose color with sulphuric acid, violet when heated; soluble in ether.

Lanthopine, $C_{23}H_{25}NO_4$. Easily soluble in chloroform, sparingly in alcohol, ether, or benzol.

Gnoscopine, $C_{34}H_{36}N_2O_{11}$. Crystallizable; soluble in chloroform, carbon disulphide, and benzol, but not in ether.

Deuteropine, $C_{20}H_{21}NO_5$. Similar to cryptopine.

Oxynarcotine, $C_{22}H_{23}NO_5$. Nearly insoluble in water, alcohol, chloroform, and benzol, but soluble in alkaline solutions.

Uses.—Opium is narcotic, sedative, and antispasmodic. The dose is one grain.

Officinal Preparations of Opium.

Extractum Opii . . . . An aqueous extract. 1 grain represents about 2 grains of opium.
Extract of Opium. Dose, one-half grain (see page 386).

Pulvis Opii . . . . . In No. 50 powder, 8 grains represent about 10 grains of opium.
Powdered Opium.

Officinal Preparations of Powdered Opium.

Opium Denarcotisatum . See page 801.
Denarcotized Opium.

Tinctura Opii . . . . . Made by macerating and percolating 10 parts of powdered opium with sufficient diluted alcohol to make 100 parts (see page 316). Dose, twelve minims.
Tincture of Opium.

Officinal Preparations of Powdered Opium.—(*Continued.*)

Tinctura Opii Deodorata . . . . Deodorized Tincture of Opium.	Made by macerating 10 parts of powdered opium with 40 parts of water, expressing, repeating, mixing the expressed liquids, evaporating to 10 parts, agitating with 20 parts of ether to dissolve the narcotine and odorous principles, separating the liquids, evaporating the aqueous portion, filtering, and adding sufficient water to make 80 parts, then adding 20 parts of alcohol (see page 317). Dose, twelve minims.
Acetum Opii . . . . . Vinegar of Opium.	Made by macerating and percolating 10 parts of powdered opium, 3 parts of nutmeg, and 20 parts of sugar, with sufficient diluted acetic acid to make 100 parts (see page 370). Dose, twelve minims.
Tinctura Opii Camphorata . . . Camphorated Tincture of Opium.	Made by macerating and percolating 4 parts each of powdered opium, benzoic acid, camphor, and oil of anise, with 40 parts of glycerin, and sufficient diluted alcohol to make 1000 parts (see page 317). Dose, one to four fluidrachms.
Vinum Opii . . . . . Wine of Opium.	Made by macerating and percolating 10 parts of powdered opium and 1 part each of cinnamon and cloves, with sufficient stronger white wine to make 100 parts (see page 325). Dose, twelve minims.
Pilulæ Opii . . . . . Pills of Opium.	Each pill contains 1 grain of powdered opium and ½ grain of soap. (See Pilulæ.)
Pulvis Ipecacuanhæ et Opii . . . Powder of Ipecac and Opium . .	10 parts each of powdered opium and ipecac, and 80 parts of sugar of milk. (See Pulveres.)

Officinal Preparations of Extract of Opium.

Emplastrum Opii . . . . . Opium Plaster.	6 parts of extract of opium, 18 parts of Burgundy pitch, and 76 parts of lead plaster. (See Emplastra.)
Trochisci Glycyrrhizæ et Opii . Troches of Glycyrrhiza and Opium.	Each troche contains $\frac{1}{10}$ grain of extract of opium and 2 grains of extract of glycyrrhiza. (See Trochisci.)

MORPHINA. *U. S.* Morphine. [MORPHIA, Pharm. 1870.]

$C_{17}H_{19}NO_3.H_2O$; 303.

Morphine was the first alkaloid to be discovered. The credit of its isolation belongs to Sertürner, an apothecary of Eimbeck, Germany, who announced its presence in opium in 1817, and named it *morphium*.

Preparation.—Morphine may be prepared by the former officinal process, as follows:

Take of Opium, sliced, 12 oz. troy; Water of Ammonia 6 fl. oz.; Animal Charcoal, in fine powder, Alcohol, Distilled Water, each, a sufficient quantity. Macerate the Opium with 4 pints of Distilled Water for twenty-four hours, and, having worked it with the hand, again macerate for twenty-four hours, and strain. In like manner, macerate the residue twice successively with the same quantity of Distilled Water, and strain. Mix the infusions, evaporate to 6 pints, and filter; then add 5 pints of Alcohol, and afterwards 3 fl. oz. of the Water of Ammonia, previously mixed with 8 fl. oz. of Alcohol. After twenty-four hours, pour in the remainder of the Water of Ammonia, mixed, as before, with 8 fl. oz. of Alcohol; and set the liquid aside for twenty-four hours that crystals may form. To purify these, boil them with 2 pints of Alcohol until they are dissolved, filter the solution, while hot, through Animal Charcoal, and set it aside to crystallize.

In this process the infusions containing the morphine, in combination with meconic and lactic acids, are treated with alcohol and water of ammonia: the former retains the coloring-matter, caoutchouc, resins,

etc., in solution, whilst the ammonia combines with the natural acids, the morphine being precipitated as an insoluble precipitate.

Morphina. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Colorless or white, shining, prismatic crystals, or a crystalline powder, permanent in the air. When heated to 120° C. (248° F.), the crystals lose their water of crystallization (5.94 per cent.). When heated on platinum foil, they fuse, then char, and are finally completely dissipated.	Odorless; bitter taste; alkaline reaction.	Cold. Very slightly soluble. Boiling. 500 parts.	Cold. 100 parts. Boiling. 36 parts.	Soluble in 13 parts of boiling absolute alcohol, almost insoluble in ether, and very slightly soluble in chloroform.

Tests for Identity.

Nitric acid first reddens Morphine and then renders it yellow. With test-solution of ferric chloride Morphine yields a blue color which is changed to green by an excess of the reagent, and which is destroyed by free acids or alcohol, but not by alkalies. A solution of Morphine, acidified with acetic or sulphuric acid, is not precipitated by tannic acid.

Morphine yields a colorless solution with cold, concentrated sulphuric acid, which should not acquire more than a reddish tint by standing for some time, and which should not assume a purple or violet, but merely a greenish color on the addition of a small crystal of bichromate of potassium (absence of and difference from strychnine, brucine, etc.). On adding 20 parts of colorless solution of soda or of potassa to 1 part of Morphine, a clear, colorless solution should result, without a residue (absence of other alkaloids).

Uses.—Morphine is rarely used medicinally, its salts—the sulphate, acetate, hydrochlorate, etc.—being preferred, because of their solubility in water.

MORPHINÆ ACETAS. *U.S.* **Acetate of Morphine.** [Morphiæ Acetas, Pharm. 1870.]

$C_{17}H_{19}NO_3.HC_2H_3O_2.3H_2O$; 399.

Preparation.—This salt may be made by the former officinal process, as follows:

Take of Morphine, in fine powder, 1 oz. troy; Distilled Water 8 fl. oz.; Acetic Acid a sufficient quantity. Mix the Morphine with the Distilled Water; then carefully drop Acetic Acid into the mixture, stirring it constantly until the Morphine is neutralized and dissolved. Evaporate the solution, by means of a water-bath, to the consistence of syrup, and set aside until it concretes. Lastly, dry the salt with a gentle heat, and rub it into powder.

Care is required not to employ too much heat in the evaporation, as the acetate is easily decomposed, a portion of the acetic acid escaping and leaving an equivalent portion of uncombined morphine.

The salt itself is subject to loss of acetic acid, and this may be discovered upon attempting to make a solution. When turbidity results, due to the inability of the water to dissolve the alkaloid, a few drops of acetic acid are needed to make the solution perfect.

Morphinæ Acetas. *U.S.*	Tests for Identity.
A white, or yellowish-white, crystalline or amorphous powder, slowly losing acetic acid when kept for some time and exposed to the air, having a faintly acetous odor, a bitter taste, and a neutral or faintly alkaline reaction. When freshly prepared, the salt is soluble in 12 parts of water and in 68 parts of alcohol at 15° C. (59° F.); if it has been kept for some time, it is incompletely soluble in water, unless a little acetic acid is added. It is also soluble in 1.5 parts of boiling water, in 14 parts of boiling alcohol, and in 60 parts of chloroform.	When heated on platinum foil, the salt is entirely dissipated. Solution of soda or potassa added to an aqueous solution of the salt throws down a white precipitate, which is soluble in an excess of the alkali. The precipitate is affected by reagents in the same manner as morphine. (See Morphina.) On adding sulphuric acid to the salt, acetous vapors are evolved.

Uses.—Acetate of morphine is narcotic and sedative. Dose, one-eighth of a grain.

MORPHINÆ HYDROCHLORAS. *U.S.* Hydrochlorate of Morphine.

$C_{17}H_{19}NO_3.HCl.3H_2O$; 375.4. [Morphiæ Murias, Pharm. 1870.]

Preparation.—This salt may be prepared by a process similar to that used for making acetate of morphine (see preceding article), by substituting hydrochloric acid for acetic acid. It is a more stable salt than the acetate.

Morphinæ Hydrochloras. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
White, feathery, flexible, acicular crystals of a silky lustre, permanent in the air. When heated to 130° C. (266° F.), the salt loses its water of crystallization (14.38 per cent.). When heated on platinum foil, it is entirely dissipated.	Odorless; bitter taste; neutral reaction.	Cold. 24 parts. Boiling. 0.5 part.	Cold. 63 parts. Boiling. 31 parts.	Insoluble in ether.

Tests for Identity.
Solution of soda or potassa added to an aqueous solution of the salt throws down a white precipitate, which is soluble in an excess of the alkali. The precipitate is affected by reagents in the same manner as morphine. (See Morphina.) The aqueous solution yields, with test-solution of nitrate of silver, a white precipitate, insoluble in nitric acid, but soluble in ammonia.

Uses.—Hydrochlorate of morphine is used as a narcotic and sedative very largely in Great Britain. The dose is one-eighth of a grain.

MORPHINÆ SULPHAS. *U.S.* Sulphate of Morphine.

$(C_{17}H_{19}NO_3)_2.H_2SO_4.5H_2O$; 758. [Morphiæ Sulphas, Pharm. 1870.]

Preparation.—This useful salt may be made by the former officinal process, as follows:

Take of Morphine, in fine powder, 1 oz. troy; Distilled Water 8 fl. oz.; Diluted Sulphuric Acid a sufficient quantity. Mix the Morphine with the Distilled Water, then carefully drop in Diluted Sulphuric Acid, con-

stantly stirring until the Morphine is neutralized and dissolved. Evaporate the solution, by means of a water-bath, so that on cooling it may crystallize. Lastly, drain the crystals, and dry them on bibulous paper.

Morphinæ Sulphas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
White, feathery, acicular crystals of a silky lustre, permanent in the air. When heated to 130° C. (266 F.), the salt loses its water of crystallization (11.87 per cent.). When heated on platinum foil, it is entirely dissipated.	Odorless; bitter taste; neutral reaction.	Cold. 24 parts. Boiling. 0.75 part.	Cold. 702 parts. Boiling. 144 parts.

Tests for Identity.

Solution of soda or potassa added to an aqueous solution of the salt throws down a white precipitate, which is soluble in an excess of the alkali. The precipitate is affected by reagents in the same manner as morphine. (See Morphina.) The aqueous solution yields, with test-solution of chloride of barium, a white precipitate insoluble in hydrochloric acid.

Uses.—Sulphate of morphine is much more largely employed in the United States than any other salt of morphine: the dose is one-eighth of a grain. The *solution of sulphate of morphine* formerly officinal was made by dissolving one grain of sulphate of morphine in one fluidounce of distilled water, and, although the solution is more stable than that of any other of the morphine salts in use, it will in time become deteriorated, either through the presence of microscopic plants or from other causes, and hence it is not desirable to keep it on hand. This solution must not be confounded with *Magendie's solution*, which is *sixteen times as strong*,—*i.e.*, sixteen grains in a fluidounce. This solution is often used hypodermically.

Officinal Preparations.

Pulvis Morphinæ Compositus . . . . Made by mixing 1 part of sulphate of morphine with 20 parts each of powdered camphor, glycyrrhiza, and precipitated carbonate of calcium. (See Pulveres.) Dose, ten grains.
Compound Morphine Powder.

Trochisci Morphinæ et Ipecacuanhæ . Each troche contains $\frac{1}{10}$ grain of sulphate of morphine and .08 grain of ipecac. (See Trochisci.)
Troches of Morphine and Ipecac.

CODEINA. *U.S.* Codeine. [Codeia.]

$C_{18}H_{21}NO_3.H_2O$; 317.

An alkaloid prepared from Opium.

When the solution of the mixed hydrochlorates of morphine and codeine is treated with ammonia, the former alkaloid is precipitated, and the codeine, remaining in solution, may be obtained by evaporation and crystallization. It may be purified by treating the crystals with hot ether, which dissolves them, and yields the codeine in colorless crystals on spontaneous evaporation.

Codeine is remarkable for being the most soluble alkaloid in use, there being no necessity for salifying it. It is usually seen in larger crystals than any other alkaloid.

Codeina. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
White, or yellowish-white, more or less translucent, rhombic prisms, somewhat efflorescent in warm air. When heated to 120° C. (248° F.), Codeine loses its water of crystallization. At about 150° C. (302° F.) it melts, and on ignition it is completely dissipated. Codeine is dissolved by sulphuric acid containing 1 per cent. of molybdate of sodium, to a liquid having at first a dirty green color, which after a while becomes pure blue and gradually fades, within a few hours, to pale yellow.	Odorless; slightly bitter taste; alkaline reaction.	Cold. 80 parts. Boiling. 17 parts.	Very soluble.	Very soluble in chloroform; also soluble in 6 parts of ether and in 10 parts of benzol, but almost insoluble in benzin.

Test for Identity and Purity.

On dissolving Codeine in sulphuric acid, a colorless liquid results, which, on the addition of a trace of ferric chloride, and gentle warming, becomes deep blue. An aqueous solution of Codeine, added to test-solution of mercuric chloride, should produce no precipitate; and if Codeine be added to nitric acid of sp. gr. 1.200, it will dissolve to a yellow liquid which should not become red (difference from and absence of morphine).

Uses.—Codeine is sedative, in doses of one-fourth to one grain.

APOMORPHINÆ HYDROCHLORAS. *U. S.* Hydrochlorate of Apomorphine.

$C_{17}H_{17}NO_2HCl$; 303.4.

Preparation.—It may be made by heating morphine in a closed tube with a great excess of hydrochloric acid for two or three hours to the temperature of 140°–150° C. (284°–302° F.). The contents of the tube are then dissolved in water, an excess of the bicarbonate of sodium added, and the precipitate exhausted with ether or chloroform. On the addition to the solution of a very small quantity of hydrochloric acid, crystals of apomorphine hydrochlorate form. The process is one of dehydration,—the morphine parting with one molecule of water, thus:

$$\underset{\text{Morphine.}}{C_{17}H_{19}NO_3} - \underset{\text{Water.}}{H_2O} = \underset{\text{Apomorphine.}}{C_{17}H_{17}NO_2}.$$

Apomorphinæ Hydrochloras. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Minute, colorless, or grayish-white, shining crystals, turning greenish on exposure to light and air. Should Hydrochlorate of Apomorphine impart color to either chloroform or ether, it should be rejected, or it may be purified by thoroughly agitating it with either liquid, filtering, and then rapidly drying the salt on bibulous paper, in a dark place. The aqueous solution, on gentle warming, rapidly turns green, but retains a neutral reaction.	Odorless; bitter taste; neutral or faintly acid reaction.	Cold. 6.8 parts. Boiling. Slowly decomposed.	Cold. 50 parts. Boiling. Slowly decomposed.	Almost insoluble in ether or chloroform.

TESTS FOR IDENTITY.

Solution of bicarbonate of sodium, added to an aqueous solution of the salt, throws down the white, amorphous alkaloid, which soon turns green on exposure to air, and forms a bluish-green solution with alcohol, a purple one with ether or pure benzol, and a violet or blue one with chloroform. Addition of test-solution of nitrate of silver to an aqueous solution of the salt produces a white precipitate insoluble in nitric acid, but instantly reduced to metallic silver by water of ammonia.

Uses.—This remarkable compound is devoid of narcotic properties, but is powerfully emetic. The dose is one-fourth grain, or, hypodermically, one-tenth grain.

CINCHONA. *U. S.* **Cinchona.**

The bark of any species of *Cinchona* (Nat. Ord. *Rubiaceæ*, *Cinchoneæ*), containing at least 3 per cent. of its peculiar alkaloids.

CINCHONA FLAVA. *U.S.* **Yellow Cinchona.** [CALISAYA BARK.]

The bark of the trunk of *Cinchona Calisaya* Weddell (Nat. Ord. *Rubiaceæ*, *Cinchoneæ*), containing at least 2 per cent. of quinine.

CINCHONA RUBRA. *U.S.* **Red Cinchona.** [RED BARK.]

The bark of the trunk of *Cinchona succirubra* Pavon (Nat. Ord. *Rubiaceæ*, *Cinchoneæ*), containing at least 2 per cent. of quinine.

The value of cinchona bark depends entirely upon the percentage of alkaloids present in it; and, as barks are found in the market greatly varying in quality, it is necessary to prove their worth by assay.

Assay of Cinchona Bark. *U.S.*

I. For Total Alkaloids.

Cinchona, in No. 80 powder, and fully dried at 100° C. (212° F.) . . **20 grammes.**
Lime . . . . . **5 grammes.**
Diluted Sulphuric Acid,
Solution of Soda,
Alcohol,
Distilled Water, each, a sufficient quantity.

Make the Lime into a milk with 50 C.c. of Distilled Water, thoroughly mix therewith the Cinchona, and dry the mixture completely at a temperature not above 80° C. (176° F.). Digest the dried mixture with 200 C.c. of Alcohol, in a flask, near the temperature of boiling, for an hour. When cool, pour the mixture upon a filter of about six inches (15 cm.) diameter. Rinse the flask and wash the filter with 200 C.c. of Alcohol, used in several portions, letting the filter drain after use of each portion. To the filtered liquid add enough Diluted Sulphuric Acid to render the liquid acid to test-paper. Let any resulting precipitate (sulphate of calcium) subside; then decant the liquid, in portions, upon a very small filter, and wash the residue and filter with small portions of Alcohol. Distil or evaporate the filtrate to expel all the Alcohol, cool, pass through a small filter, and wash the latter

with Distilled Water slightly acidulated with Diluted Sulphuric Acid, until the washings are no longer made turbid by Solution of Soda. To the filtered liquid, concentrated to the volume of about 50 C.c., when nearly cool, add enough Solution of Soda to render it strongly alkaline. Collect the precipitate on a wetted filter, let it drain, and wash it with small portions of Distilled Water (using as little as possible), until the washings give but a slight turbidity with test-solution of chloride of barium. Drain the filter by laying it upon blotting- or filter-papers until it is nearly dry. Detach the precipitate carefully from the filter and transfer it to a weighed capsule, wash the filter with Distilled Water acidulated with Diluted Sulphuric Acid, make the filtrate alkaline by Solution of Soda, and, if a precipitate result, wash it on a very small filter, let it drain well, and transfer it to the capsule. Dry the contents of the latter at 100° C. (212° F.) to a constant weight, cool it in a desiccator, and weigh. The number of grammes, multiplied by *five*, equals the percentage of total alkaloids in the Cinchona.

II. For Quinine.

To the total alkaloids from 20 grammes of Cinchona, previously weighed, add Distilled Water acidulated with Diluted Sulphuric Acid, until the mixture remains for ten or fifteen minutes after digestion, just distinctly acid to test-paper. Transfer to a weighed beaker, rinsing with Distilled Water, and adding of this enough to make the whole weigh *seventy times* the weight of the alkaloids. Add now, in drops, Solution of Soda previously well diluted with Distilled Water, until the mixture is exactly neutral to test-paper. Digest at 60° C. (140° F.) for five minutes, then cool to 15° C. (59° F.) and maintain at this temperature for half an hour. If crystals do not appear in the glass vessel, the total alkaloids do not contain quinine in quantity over *eight per cent.* of their weight (corresponding to *nine per cent.* of sulphate of quinine, crystallized). If crystals appear in the mixture, pass the latter through a filter not larger than necessary, prepared by drying two filter-papers of two to three and a half inches (5 to 9 cm.) diameter, trimming them to an equal weight, folding them separately, and placing one within the other so as to make a plain filter four-fold on each side. When the liquid has drained away, wash the filter and contents with Distilled Water of a temperature of 15° C. (59° F.), added in small portions, until the entire filtered liquid weighs *ninety times* the weight of the alkaloids taken. Dry the filter, without separating its folds, at 60° C. (140° F.) to a constant weight, cool, and weigh the inner filter and contents, taking the outer filter for a counter-weight. To the weight of effloresced sulphate of quinine so obtained, add 11.5 per cent. of its amount (for water of crystallization), and add 0.12 per cent. of the weight of the entire filtered liquid (for solubility of the crystals at 15° C. or 59° F.). The sum in grammes, multiplied by *five*, equals the percentage of crystallized sulphate of quinine equivalent to the quinine in the Cinchona.

About twenty alkaloids have been discovered in cinchona barks. Some of these are found only in one kind of bark, some are doubtless

"split products,"—that is, not existing naturally in the bark, but the result of the action of chemical agents upon it.

Quinine, *Quinidine*, *Cinchonine*, and *Cinchonidine* are the most important alkaloids found in cinchona barks, and they, or their important salts, will be considered in separate articles. The acids present are *kinic*, or *quinic*, *cinchotannic*, and *kinovic*, or *quinovic*. The neutral principle is *kinovin*, or *quinovin*, whilst *cinchonic red*, volatile oil, and red and yellow coloring-matter are also present. The first four of the alkaloids in the following list are used practically. The full list is as follows:

Natural Alkaloids.—1. Quinine, $C_{20}H_{24}N_2O_2$. 2. Quinidine (Conchinine of Hesse), $C_{20}H_{24}N_2O_2$. 3. Cinchonine, $C_{20}H_{24}N_2O$. 4. Cinchonidine, $C_{20}H_{24}N_2O$. 5. Quinamine, $C_{19}H_{24}N_2O_2$. 6. Quinidamine (Conchinamine of Hesse), $C_{19}H_{24}N_2O_2$. 7. Homoquinine or Ultraquinine. 8. Cinchonamine. 9. Paytine, $C_{21}H_{24}N_2OH_2O$. 10. Homocinchonine, $C_{19}H_{22}N_2O$. 11. Homocinchonidine, $C_{19}H_{22}N_2O$. 12. Cusconine, $C_{23}H_{26}N_2O_4 2H_2O$. 13. Cusconidine. 14. Aricine (Cinchovatine of Manzini), $C_{23}H_{26}N_2O_4$. 15. Paricine, $C_{16}H_{18}N_2O$. 16. Paytamine. 17. Dihomocinchonine. 18. Dicinchonine, $C_{40}H_{48}N_4O_2$? 19. Diquinidine (Diconchinine of Hesse), $C_{40}H_{46}N_4O_3$. 20. Javanine. 21. Cincholine.

The Artificial Alkaloids at present known are: 1. Quinicine, $C_{20}H_{24}N_2O_2$. 2. Cinchonicine, $C_{20}H_{24}N_2O$. 3. Quinamicine, $C_{19}H_{24}N_2O_2$. 4. Quinamidine, $C_{19}H_{24}N_2O_2$. 5. Protoquinamicine, $C_{17}H_{20}N_2O_2$. 6. Apoquinamine, $C_{19}H_{22}N_2O$. 7. Homocinchonicine, $C_{19}H_{22}N_2O$. 8. Hydrocinchonine, $C_{20}H_{26}N_2O$. These are chiefly produced by the action of heat upon the natural alkaloids.

One of the principal difficulties in preserving galenical preparations of cinchona arises from the alteration and precipitation which the cinchotannic acid and its compounds undergo upon keeping. Glycerin has proved to be very useful by dissolving and holding these in solution, and hence it is present in nearly every one of the preparations.

Officinal Preparations.

Infusum Cinchonæ . . . . . Made by percolating 6 parts of cinchona with water containing 1 per cent. of aromatic sulphuric acid to obtain 100 parts.
Infusion of Cinchona.

Extractum Cinchonæ . . . . . Made from yellow cinchona with a menstruum of 3 parts of alcohol and 1 part of water, adding 5 per cent. of glycerin to the finished extract (see page 379).
Extract of Cinchona.

Extractum Cinchonæ Fluidum . Made from yellow cinchona with a menstruum of 3 parts of alcohol and 1 part of glycerin, finishing with a menstruum of 3 parts of alcohol and 1 part of water (see page 341). Dose, one to two fluidrachms.
Fluid Extract of Cinchona.

Tinctura Cinchonæ . . . . . Made by percolating 20 parts of yellow cinchona with a menstruum of 65 parts of alcohol, 25 parts of water, and 10 parts of glycerin to obtain 100 parts (see page 308). Dose, one to four fluidrachms.
Tincture of Cinchona.

Tinctura Cinchonæ Composita . Made by percolating 10 parts of *red* cinchona, 8 parts of bitter orange peel, and 2 parts of serpentaria with a menstruum of 8 parts of alcohol, 1 part of water, and 1 part of glycerin to obtain 100 parts (see page 309). Dose, one to four fluidrachms.
Compound Tincture of Cinchona.

QUININA. *U.S.* Quinine.

$C_{20}H_{24}N_2O_2.3H_2O$ (crystallized); 378.

Preparation.—This alkaloid is usually made by adding to the acid solution of the sulphate a quantity of water of ammonia or solution

of soda just sufficient to precipitate the quinine, carefully avoiding an excess.

Quinina. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A white, flaky, amorphous or minutely crystalline powder, permanent in the air. When heated to 57° C. (134.6° F.), it melts, and, at the temperature of the water-bath, loses about 9 per cent. (about 2 molecules) of its water of crystallization, the remainder being expelled at 125° C. (257° F.). On ignition, the alkaloid burns slowly without leaving a residue.	Odorless; very bitter taste; alkaline reaction.	Cold. 1600 parts. Boiling. 700 parts.	Cold. 6 parts. Boiling. 2 parts.	Soluble in 25 parts of ether, in about 5 parts of chloroform, in about 200 parts of glycerin, and also soluble in benzin, benzol, water of ammonia, or in diluted acids, which latter it neutralizes.

Tests for Identity.	Impurities.	Tests for Impurities.
The solution of Quinine in diluted sulphuric acid has a vivid, blue fluorescence. Treated, first, with fresh chlorine water, and then with a slight excess of water of ammonia, Quinine produces an emerald-green color. Quinine should not be reddened by nitric acid (difference from morphine).	Foreign Organic Matters.	Quinine should afford no color, or none darker than a pale yellow, with undiluted sulphuric acid.
	Absence of more than 1 per cent. of Cinchonidine and Quinidine, and more than traces of Cinchonine.	If 1 Gm. of Quinine be mixed, in a mortar, with 0.5 Gm. of sulphate of ammonium and 5 C.c. of distilled water, the mixture thoroughly dried on the water-bath, the residue (which should be neutral to test-paper) agitated with 10 C.c. of distilled water, this mixture macerated at 15° C. (59° F.) for half an hour, then filtered through a small filter, 5 C.c. of the filtrate taken in a test-tube, and 7 C.c. of water of ammonia (sp. gr. 0.960) then added,—on closing the test-tube with the finger and gently turning it until the ammonia is fully intermixed, a clear liquid should be obtained. If the temperature of maceration has been 16° C. (60.8° F.), 7.5 C.c. of the water of ammonia may be added; if 17° C. (62.6° F.), 8 C.c. may be added. In each instance a clear liquid indicates the absence of more than about 1 per cent. of cinchonidine and quinidine, and of more than traces of cinchonine.

Uses.—The alkaloid quinine is never used medicinally. Pharmaceutically, it is employed in making elixirs, in citrate of iron and quinine and its solution, and in syrup of the phosphates of iron, quinine, and strychnine.

QUININÆ SULPHAS. *U.S.* **Sulphate of Quinine.** [Quiniæ Sulphas. Pharm. 1870.]

$(C_{20}H_{24}N_2O_2)_2H_2SO_4.7H_2O$; 872.

Preparation.—The processes which are used for making sulphate of quinine, commercially, are regarded as valuable trade secrets, and the manufacturers carefully guard them. The following process, which was formerly officinal, illustrates one method of making the sulphate of the principal alkaloid from cinchona:

Take of Yellow Cinchona, in coarse powder, 48 oz. troy; Hydro-

chloric Acid 3½ oz. troy; Lime, in fine powder, 5 oz. troy; Animal Charcoal, in fine powder, Sulphuric Acid, Alcohol, Water, Distilled Water, each, a sufficient quantity. Boil the Cinchona in 13 pints of water mixed with one-third of the Hydrochloric Acid, and strain through muslin. Boil the residue twice successively with the same quantity of Water and Acid as before, and strain. Mix the decoctions, and, while the liquid is hot, gradually add the Lime, previously mixed with 2 pints of Water, stirring constantly, until the quinine is completely precipitated. Wash the precipitate with Distilled Water, and, having pressed, dried, and powdered it, digest it in boiling Alcohol. Pour off the liquid, and repeat the digestion several times, until the Alcohol is no longer rendered bitter. Mix the liquids, and distil off the Alcohol until a brown viscid mass remains. Upon this, transferred to a suitable vessel, pour 4 pints of Distilled Water, and, having heated the mixture to the boiling point, add as much Sulphuric Acid as may be necessary to dissolve the quinine. Then add 1½ oz. troy of Animal Charcoal, boil the liquid for two minutes, filter while hot, and set it aside to crystallize. Should the liquid, before filtration, be entirely neutral, acidulate it very slightly with Sulphuric Acid; should it, on the contrary, change the color of litmus paper to a bright red, add more Animal Charcoal. Separate the crystals from the liquid, dissolve them in boiling Distilled Water slightly acidulated with Sulphuric Acid, add a little Animal Charcoal, filter the solution, and set it aside to crystallize. Lastly, dry the crystals on bibulous paper with a gentle heat, and keep them in a well-stopped bottle. The mother-water may be made to yield an additional quantity of Sulphate of Quinine by precipitating the quinine with Water of Ammonia, and treating the precipitated alkaloid with Distilled Water, Sulphuric Acid, and Animal Charcoal, as before.

The hydrochloric acid forms with the alkaloids soluble hydrochlorates. The lime decomposes the salts by uniting with the acid, and the alkaloids are precipitated with the excess of lime. These are dissolved out with boiling alcohol, the solution evaporated, acidulated with sulphuric acid, decolorized with animal charcoal, and crystallized.

Soda is often used instead of lime to precipitate the alkaloids, because quinine is less soluble in a solution of sodium chloride than in calcium chloride; whilst several manufacturers prefer to use amylic alcohol for exhausting the lime precipitate of alkaloids. Oil of turpentine has also been substituted to some extent.

There are at least three sulphates of quinine that have been obtained, of which two are now officinal. The first of these, $(C_{20}H_{24}N_2O_2)_2H_2SO_4 + 7H_2O$, is a "diquinic sulphate," and is known and prescribed in Great Britain as *Quininæ Disulphas;* it is the officinal salt known as quinine sulphate, or *Quininæ Sulphas*, U.S.; the second, formed by dissolving this first in dilute sulphuric acid, has the formula $C_{20}H_{24}N_2O_2H_2SO_4 + 7H_2O$, and is the officinal bisulphate of quinine, or *Quininæ Bisulphas*, U.S.; while the third, which is not officinal, is the acid sulphate, $C_{20}H_{24}N_2O_2,2H_2SO_4 + 7H_2O$, and may be obtained from a solution of quinine in an excess of dilute sulphuric acid.

Quininæ Sulphas. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Snow-white, loose, filiform crystals, fragile and somewhat flexible, making a very light and easily compressible mass, lustreless from superficial efflorescence after standing in the air. When long exposed to the air, or when kept at 50° to 60° C. (122° to 140° F.) for some hours, it loses most of its water of crystallization (all except 4.6 per cent., or 2 to 3 molecules of water), the last portion being slowly expelled at 100° to 115° C. (212° to 239° F.). On ignition, the salt burns slowly without leaving a residue.	Odorless; persistent, very bitter taste; neutral reaction.	Cold. 740 parts. Boiling. 30 parts.	Cold. 65 parts. Boiling. 3 parts.	Soluble in small proportions of acidulated water, in 40 parts of glycerin, in 1000 parts of chloroform, and very slightly soluble in ether. 20 C.c. of absolute alcohol should dissolve 0.2 Gm. of the salt, forming a clear liquid.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution of the salt, especially when acidulated with sulphuric acid, has a vivid blue fluorescence. When treated, first, with fresh chlorine water, and then with a slight excess of water of ammonia, the salt produces an emerald-green color. Water of ammonia added to the aqueous solution of the salt throws down a white precipitate readily soluble in an excess of water of ammonia, and soluble in about 20 times its weight of ether (the other cinchona alkaloids requiring larger proportions of ether or of water of ammonia for solution). Dissolved in water, it yields, with test-solution of chloride of barium, a white precipitate insoluble in hydrochloric acid. The salt should not be reddened by nitric acid (difference from morphine).	Foreign Organic Matters.	The salt should not be colored, or not more than very slightly colored, by undiluted sulphuric acid.
	Ammonium Salts.	If a portion of the salt be boiled with milk of lime, no ammoniacal vapor should be given off.
	More than 8 molecules, or 16.18 per cent., of Water.	If 1 Gm. of the salt be placed in a porcelain capsule, and dried at a temperature of 100° C. (212° F.) for three hours, or until a constant weight is attained, the remainder, cooled in a desiccator, should weigh not less than 0.838 Gm.
	Absence of more than about 1 per cent. of Cinchonidine or Quinidine, and of more than traces of Cinchonine.	If the residue thus dried at 100° C. (212° F.) be agitated with 10 C.c. of distilled water, the mixture macerated at 15° C. (59° F.) for half an hour, then filtered through a small filter, 5 C.c. of the filtrate taken in a test-tube, and 7 C.c. of water of ammonia (sp. gr. 0.960) then added,—on closing the test-tube with the finger and gently turning it until the ammonia is fully intermixed, a clear liquid should be obtained. If the temperature of maceration has been 16° C. (60.8° F.), 7.5 C.c. of the water of ammonia may be added; if 17° C. (62.6° F.), 8 C.c. may be added.

Uses.—Sulphate of quinine is used as an antiperiodic, tonic, and antipyretic. The dose varies from two to twenty grains. It may be given in the form of pills or in solution: in the latter case it is better to suspend it in syrup without using acid, with the addition of a little fluid extract of glycyrrhiza and a drop of water of ammonia.

QUININÆ BISULPHAS. *U.S.* Bisulphate of Quinine.

$C_{20}H_{24}N_2O_2H_2SO_4.7H_2O$; 548.

Preparation.—This salt is made by adding sulphuric acid to quinine sulphate suspended in water, evaporating the solution, and crystallizing the bisulphate.

Quininæ Bisulphas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, clear, orthorhombic crystals, or small needles, efflorescing and becoming opaque on exposure to air. At 100° C. (212° F.) it loses all its water of crystallization, and at 135° C. (275° F.) it is converted into bisulphate of quinicine. On ignition, the salt burns slowly without leaving a residue.	Odorless; very bitter taste; strongly acid reaction.	Cold. 10 parts (with vivid blue fluorescence). Boiling. Very soluble.	Cold. 32 parts. Boiling. Very soluble.

Tests for Identity.	Impurities.	Tests for Impurities.
Treated, first, with fresh chlorine water, and then with a slight excess of water of ammonia, it produces an emerald-green color. Its aqueous solution yields, with water of ammonia, a precipitate readily soluble in an excess of water of ammonia, or in ether. With test-solution of chloride of barium it produces a white precipitate insoluble in hydrochloric acid. The salt should not be reddened by nitric acid (difference from morphine).	Foreign Organic Matters.	The salt should not be colored, or not more than very slightly colored, by undiluted sulphuric acid.
	Free Water.	If 1 Gm. of Bisulphate of Quinine be dried, on a water-bath, to constant weight, the residue should weigh not less than 0.77 Gm.
	See Quinina.	If 1 Gm. of the salt, previously dried at 100° C. (212° F.), be agitated with 8 C.c. of distilled water, the mixture made exactly neutral to test-paper by the cautious addition of water of ammonia, then increased by the addition of distilled water to 10 C.c., and macerated at 15° C. (59° F.) for half an hour, upon proceeding further as directed for the corresponding test under quinine (see Quinina) the results there given should be obtained.

Uses.—The bisulphate has been introduced into medicine in preference to the ordinary sulphate, because of its greater solubility: being seventy times more soluble, it is better adapted for making into pills than the sulphate. It contains 13 per cent. less of the alkaloid than does the sulphate. The difference is to some extent compensated for by the greater solubility, and the dose given is usually that of the sulphate.

QUININÆ HYDROCHLORAS. *U.S.* Hydrochlorate of Quinine.

$C_{20}H_{24}N_2O_2HCl.2H_2O$; 396.4.

Preparation.—Quinine hydrochlorate may be made by double decomposition between quinine sulphate and barium chloride, or by dissolving the alkaloid quinine in diluted hydrochloric acid, evaporating, and crystallizing.

Quininæ Hydrochloras. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
White, lustrous needles, forming tufts, permanent in ordinary air, but readily efflorescing at a gentle heat. On ignition, the salt burns slowly without leaving a residue.	Odorless; very bitter taste; neutral or faintly alkaline reaction.	Cold. 34 parts. Boiling. 1 part.	Cold. 3 parts. Boiling. Very soluble.	When rendered anhydrous, it is soluble in 1 part of chloroform.

Tests for Identity.	Impurities.	Tests for Impurities.
The saturated, aqueous solution does not show any blue fluorescence, which, however, appears, in some degree, in more dilute solutions, if not acidulated. When treated, first, with fresh chlorine water, and then with a slight excess of water of ammonia, it produces an emerald-green color. Water of ammonia added to the aqueous solution throws down a white precipitate readily soluble in an excess of water of ammonia, or in ether. Test-solution of nitrate of silver produces a white precipitate insoluble in nitric acid, but soluble in ammonia.	Foreign Organic Matters.	The salt should not be colored, or only very slightly colored, by undiluted sulphuric acid.
	Barium.	The aqueous solution of the salt should not be rendered turbid by diluted sulphuric acid.
	Sulphate.	The aqueous solution of the salt should not be rendered more than slightly turbid by test-solution of chloride of barium.
The salt should not be reddened by nitric acid (difference from morphine).	See Quinina.	If a small portion of the salt be dried on a water-bath until it ceases to lose weight, and the residue cooled in a desiccator, the loss of weight should not exceed 9 per cent. If 1.5 Gm. be dissolved in 15 C.c. of hot distilled water, the solution stirred with 0.75 Gm. of crystallized sulphate of sodium in powder, the mixture maintained at 15° C. (59° F.) for half an hour, and then drained through a filter only large enough to contain it, until 5 C.c. of filtrate are obtained, upon treating this liquid as directed for the corresponding test under quinine (see Quinina) the results there given should be obtained.

Uses.—This salt is used like the sulphate: it is much more soluble, and is preferable for hypodermic use. The dose is from two to twenty grains.

QUININÆ HYDROBROMAS. *U.S.* Hydrobromate of Quinine.

$C_{20}H_{24}N_2O_2HBr.2H_2O$; 440.8.

Preparation.—Quinine hydrobromate may be made by decomposing 40 parts of quinine sulphate dissolved in 400 parts of hot alcohol with 11 parts of potassium bromide dissolved in 30 parts of distilled water. Potassium sulphate crystallizes out, and the quinine hydrobromate in solution may be obtained by evaporation and crystallization.

In drying the salt, care must be observed not to subject the crystals to heat sufficient to fuse them: a warm dry atmosphere should be relied upon to effect the drying, and all unnecessary exposure to light should be avoided.

Quinine hydrobromate may also be made by double decomposition between quinine sulphate and barium bromide, both in hot alcoholic solution. It is sometimes made by dissolving the alkaloid quinine in hot diluted hydrobromic acid until the latter is no longer acid to litmus paper, evaporating, and crystallizing.

Quininæ Hydrobromas. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Colorless, lustrous needles, permanent in ordinary air, but readily effloresecing at a gentle heat. On ignition, the salt burns slowly without leaving a residue.	Odorless; very bitter taste; neutral or slightly alkaline reaction.	Cold. 16 parts. Boiling. 1 part.	Cold. 3 parts. Boiling. Less than 1 part.	Soluble in 6 parts of ether, 12 parts of chloroform, and moderately soluble in glycerin.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution, when acidulated with sulphuric acid, has a blue fluorescence, and, when treated, first, with fresh chlorine water, and then with a slight excess of water of ammonia, it produces an emerald-green color. Water of ammonia added to the aqueous solution throws down a white precipitate readily soluble in an excess of water of ammonia, or in ether. Test-solution of nitrate of silver produces a white precipitate which is insoluble in diluted nitric acid, and, when filtered off and washed, insoluble in solution of carbonate of ammonium. The salt should not be reddened by nitric acid (difference from morphine).	Foreign Organic Matters.	The salt should not be colored, or not more than very slightly colored, by undiluted sulphuric acid.
	Free Water.	If a small portion of the salt be dried on the water-bath until it ceases to lose weight, and the residue cooled in a desiccator, the loss of weight should not exceed 8.2 per cent.
	Barium.	The aqueous solution of the salt should not be rendered turbid by diluted sulphuric acid.
	Sulphate.	The aqueous solution of the salt should not be rendered more than slightly turbid by test-solution of chloride of barium.
	See Quinina.	If 1.5 Gm. of the salt be dissolved in 15 C.c. of hot distilled water, the solution stirred with 0.6 Gm. of crystallized sulphate of sodium in powder, the mixture maintained at 15° C. (59° F.) for half an hour and then drained through a filter only large enough to contain it, until 5 C.c. of filtrate are obtained, upon treating this liquid as directed for the corresponding test under quinine (see Quinina) the results there given should be obtained.

Uses.—Hydrobromate of quinine is sometimes used hypodermically. Its dose is that of the sulphate, two to twenty grains.

QUININÆ VALERIANAS. *U. S.* Valerianate of Quinine.

$C_{20}H_{24}N_2O_2C_5H_{10}O_2.H_2O$; 444.

Preparation.—In the former officinal process quinine was first obtained by decomposing the sulphate, by means of ammonia, and then combining it directly with valerianic acid, to form quinine valerianate, which crystallized from the solution when it cooled, because it is much less soluble in cold than in hot water.

Quininæ Valerianas. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
White, or nearly white, pearly, lustrous, triclinic crystals, permanent in the air, and slightly soluble in ether. When heated to about 90° C. (194° F.), the salt melts, forming a colorless liquid. On ignition, it burns slowly without leaving a residue.	Slight odor of valerianic acid; bitter taste; neutral reaction.	Cold. 100 parts. Boiling. 40 parts.	Cold. 5 parts. Boiling. 1 part.	Slightly soluble in ether.?

Care must be observed in evaporating the solution and in drying this salt, because of its tendency to decompose. It may also be made by acting on an alcoholic solution of quinine sulphate with sodium valerianate. Quinine valerianate has been known to emit a phosphorescent light in the dark when rubbed in a mortar with a pestle.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution, when acidulated with sulphuric acid, has a blue fluorescence, and emits the odor of valerianic acid. When treated, first, with fresh chlorine water, and then with a slight excess of water of ammonia, it produces an emerald-green color. Water of ammonia added to the aqueous solution throws down a white precipitate readily soluble in an excess of water of ammonia, or in ether. The salt should not be reddened by nitric acid (difference from morphine).	Foreign Organic Matters.	The salt should not be colored, or not more than slightly colored, by undiluted sulphuric acid.
	Sulphate.	The addition of test-solution of chloride of barium to the aqueous solution of the salt should not cause more than a slight precipitate.

Uses.—This salt has no especial advantages over the sulphate. The proportion of valerianic acid is too small to have any influence as a nervine. Dose, two to ten grains.

QUINIDINÆ SULPHAS. *U. S.* Sulphate of Quinidine.

$(C_{20}H_{24}N_2O_2)_2H_2SO_4.2H_2O$; 782.

Preparation.—This salt is obtained from the mother-liquors obtained after the crystallization of quinine.

Quinidinæ Sulphas. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
White, silky needles, permanent in the air. On ignition, the salt burns slowly without leaving a residue. It parts with its water of crystallization (4.3 per cent. by weight) at 120° C. (248° F.).	Odorless; very bitter taste; neutral or faintly alkaline reaction.	Cold. 100 parts. Boiling. 7 parts.	Cold. 8 parts. Boiling. Very soluble.	Very soluble in acidulated water and in 20 parts of chloroform, but almost insoluble in ether.

Tests for Identity.	Impurities.	Tests for Impurities.
The aqueous solution, when acidulated with sulphuric acid, has a decided blue fluorescence. When treated, first, with fresh chlorine water, and then with a slight excess of water of ammonia, the salt produces an emerald-green color. If a little water of ammonia is added to a solution of the salt, a white precipitate (Quinidine) is produced, which requires a considerable excess of water of ammonia, or about 30 times its weight of ether, to dissolve it. Test-solution of chloride of barium added to an aqueous solution of the salt throws down a white precipitate insoluble in hydrochloric acid. The salt should not be reddened by nitric acid (difference from morphine).	Foreign Organic Matters.	The salt should not be colored, or not more than very slightly colored, by undiluted sulphuric acid.
	More than small proportions of Cinchonine, Cinchonidine, or Quinine.	If 0.5 Gm., each, of Sulphate of Quinidine and of iodide of potassium (not alkaline to test-paper) be agitated with 10 C.c. of water at about 60° C. (140° F.), the mixture then macerated at 15° C. (59° F.) for half an hour, with frequent stirring, and filtered, the addition, to the filtrate, of a drop or two of water of ammonia should not cause more than a slight turbidity.

Quinidine differs from quinine in being dextrogyre (quinine is lævogyre), and in being almost insoluble in ether.

Uses.—This salt is equally efficient with sulphate of quinine in the treatment of malaria and as an antiperiodic and antipyretic. Dose, two to twenty grains.

CINCHONINA. *U.S.* Cinchonine. [CINCHONIA.]

$C_{20}H_{24}N_2O$; 308.

Preparation.—Cinchonine may be obtained from the mother-waters of quinine sulphate by diluting them with water, precipitating with ammonia, collecting the precipitate on a filter, washing and drying it, and then dissolving it in boiling alcohol, which deposits the cinchonine in a crystalline form upon cooling. It may be still further purified by a second solution and crystallization.

Cinchonina. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
White, somewhat lustrous prisms or needles, permanent in the air. At about 250° C. (482° F.) it melts and turns brown with partial sublimation. On ignition, the alkaloid is dissipated without leaving a residue.	Odorless; at first nearly tasteless, but developing a bitter aftertaste; alkaline reaction.	Cold. Almost insoluble. Boiling. Almost insoluble.	Cold. 110 parts. Boiling. 28 parts.	In 371 parts of ether, 350 parts of chloroform, and readily soluble in diluted acids, forming salts of a very bitter taste.

Test for Identity.	Impurities.	Tests for Impurities.
On precipitating the alkaloid from a solution of the alkaloid in diluted sulphuric acid by water of ammonia, it is very sparingly dissolved by the latter (difference from and absence of quinine), and requires at least 300 parts of ether for solution (difference from quinine, quinidine, and cinchonidine).	More than traces of Quinine or Quinidine.	A solution of the alkaloid in diluted sulphuric acid should not exhibit more than a faint blue fluorescence.
	Foreign Organic Matters.	The salt should not be colored, or but very slightly colored, by the addition of sulphuric acid.

Uses.—Cinchonine is not used medicinally, because of its insolubility in water. It is used pharmaceutically to some extent in elixirs, etc., as it is more soluble in alcohol.

CINCHONINÆ SULPHAS. *U.S.* Sulphate of Cinchonine. [CINCHONIÆ SULPHAS, Pharm. 1870.]

$(C_{20}H_{24}N_2O)_2H_2SO_4.2H_2O$; 750.

Preparation.—In consequence of its greater solubility, sulphate of cinchonine remains behind in the mother-waters, when sulphate of quinine crystallizes, in the process for preparing the latter. Cinchonine is obtained from quinine mother-liquors by precipitation with solution of soda. The precipitated cinchonine is washed, converted into a sulphate by the addition of sulphuric acid, decolorized, and crystallized.

Cinchoninæ Sulphas. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Hard, white, shining prisms of the clino-rhombic system, permanent in the air. At 100° C. (212° F.) the salt loses its water of crystallization, and at about 240° C. (464° F.) it melts with partial sublimation. On ignition, the salt is dissipated without leaving a residue. The aqueous solution of the salt yields a curdy precipitate with test-solution of iodide of mercury and potassium.	Odorless; very bitter taste; neutral or faintly alkaline reaction.	Cold. 70 parts. Boiling. 14 parts.	Cold. 6 parts. Boiling. 1.5 parts.	In 60 parts of chloroform, and easily soluble in diluted acids; insoluble in ether or benzol.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
The salt yields with water of ammonia a white precipitate (Cinchonine) which is very sparingly soluble in an excess of ammonia (difference from quinine), and not soluble in less than 300 parts of ether (difference from quinine, quinidine, and cinchonidine). With test-solution of chloride of barium it yields a white precipitate insoluble in hydrochloric acid.	More than traces of Sulphate of Quinine or of Quinidine.	A moderately dilute solution of the salt, acidulated with sulphuric acid, should not show more than a faint blue fluorescence.
If the salt, dried at a gentle heat, be macerated, for half an hour, with frequent agitation, with 70 times its weight of chloroform at 15° C. (59° F.), it should wholly, or almost wholly, dissolve (any more than traces of sulphate of quinine or sulphate of cinchonidine remaining undissolved).	More than 6 per cent. of Moisture.	If 1 Gm. be dried at 100° C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0.952 Gm.
	Foreign Organic Matters.	The salt should not be colored by contact with sulphuric acid.

Uses.—Cinchonine sulphate is used as a tonic and febrifuge. Its cheapness has led to its extensive employment as a substitute for quinine. The dose is larger, however, as an antiperiodic: fifteen to forty grains have been given.

CINCHONIDINÆ SULPHAS. *U. S.* Sulphate of Cinchonidine.

$(C_{20}H_{24}N_2O)_2H_2SO_4.3H_2O$; 768.

Preparation.—This alkaloidal salt is also obtained from the quinine mother-liquors by fractional crystallization. The Indian barks contain a larger proportion of it than the South American varieties.

Cinchonidinæ Sulphas. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
White, silky, lustrous needles, or thin quadratic prisms. At 100° C. (212° F.) the salt loses its water of crystallization. From a dilute aqueous solution the salt crystallizes with 13.13 per cent. (6 to 7 mol.) of water of crystallization; from a concentrated aqueous solution, with 7.03 per cent. (3 to 4 mol.).	Odorless; very bitter taste; neutral or faintly alkaline reaction.	Cold. 100 parts. Boiling. 4 parts.	Cold. 71 parts. Boiling. 12 parts.	Freely soluble in acidulated water, and in 1000 parts of chloroform (the undissolved portions becoming gelatinous); very sparingly soluble in ether or benzol.

Tests for Identity.	Impurities.	Tests for Impurities.
On ignition, the salt is dissipated without leaving a residue. The aqueous solution of the salt yields, on addition of water of ammonia, a white precipitate (Cinchonidine) which requires a large excess of ammonia to dissolve it, and which is soluble in about 75 times its weight of ether. With test-solution of iodide of mercury and potassium, the aqueous solution yields a curdy precipitate, and with test-solution of chloride of barium a white precipitate insoluble in hydrochloric acid.	More than traces of Sulphate of Quinine, or of Quinidine.	The moderately dilute aqueous solution of the salt, acidulated with sulphuric acid, should not show more than a slight blue fluorescence.
	Foreign Organic Matters.	The salt should not be colored by the addition of sulphuric acid.
	More than 8 per cent. of Moisture.	If 1 Gm. be dried at 100° C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0.92 Gm.
	More than 0.5 per cent. of Sulphate of Cinchonine, or more than 1.5 per cent. of Sulphate of Quinidine.	If 0.5 Gm. of the salt be digested with 20 C.c. of cold distilled water, 0.5 Gm. of tartrate of potassium and sodium added, the mixture macerated, with frequent agitation, for one hour at 15° C. (59° F.), then filtered, and a drop of water of ammonia added to the filtrate, not more than a slight turbidity should appear.

Uses.—This salt closely resembles quinine sulphate in its medicinal effects, and may be used for the same purposes in somewhat larger doses.

CHINOIDINUM. *U.S.* Chinoidin. [Quinoidin.]

A mixture of alkaloids, mostly amorphous, obtained as a by-product in the manufacture of the crystallizable alkaloids from Cinchona.

Preparation.—When the quinine mother-liquors are precipitated with soda, an amorphous resinous mass separates, which consists of the uncrystallizable alkaloids: these have probably lost their power of forming crystalline bodies, because of the continued action of heat to which they have been subjected during the evaporation of their solutions. A somewhat analogous case is presented in the process for making cane-sugar and molasses. Chinoidin—or, as it should be spelled, chinoidine—consists largely of *quinicine* and *cinchonicine*, alkaloids isomeric with quinine and cinchonine, and produced by the action of heat upon the latter.

Chinoidinum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A brownish-black or almost black solid, breaking, when cold, with a resinous, shining fracture, becoming plastic when warmed.	Odorless; bitter taste; alkaline reaction.	Almost insoluble.	Freely soluble.	Freely soluble in chloroform and diluted acids; partially soluble in ether and benzol.

Tests for Identity.	Impurities.	Test for Impurities.
The solutions of Chinoidin have a very bitter taste. On ignition, Chinoidin should not leave more than 0.7 per cent. of ash.	Alkaloidal Salts.	If Chinoidin be triturated with boiling water, the liquid, after filtration, should be clear and colorless, and should remain so on the addition of an alkali.

Uses.—Chinoidine, although cheaper than the cinchona alkaloids, is not preferred to them, because of its uncertain action, due to the varying proportions of uncrystallizable alkaloids present. It is used as a tonic and antiperiodic. Dose, five to thirty grains.

NUX VOMICA. *U.S.* Nux Vomica.

The seed of *Strychnos Nux-vomica* Linné (Nat. Ord. *Loganiaceæ*).

Nux vomica contains *strychnine*, *brucine*, $C_{23}H_{26}N_2O_4$, probably *igasurine*, *igasuric acid*, protein compounds, gum, fixed oil, sugar, etc. Strychnine is officinal, and it will be considered separately. Brucine is easily soluble in alcohol and in chloroform; it is colored bright red by nitric acid, and its solution acquires a rose-red coloration with chlorine water. The presence of igasurine is now considered doubtful. The fixed oil is soluble in alcohol, and the alkaloids are soluble in the oil: in making the extract the oil should be separated and shaken with diluted alcohol to dissolve the alkaloids. This solution should be evaporated and mixed with the extract. Nux vomica is poisonous in large doses; in doses of three grains it is tonic.

Officinal Preparations.

Abstractum Nucis Vomicæ . . . . Abstract of Nux Vomica.	Made with a menstruum of 8 parts of alcohol and 1 part of water: each grain represents 2 grains of nux vomica (see page 393). Dose, one to two grains.
Extractum Nucis Vomicæ . . . . . Extract of Nux Vomica.	Made with a menstruum of 8 parts of alcohol and 1 part of water (see page 385). Dose, one-half to two grains.
Extractum Nucis Vomicæ Fluidum . Fluid Extract of Nux Vomica.	Made with a menstruum of 8 parts of alcohol and 1 part of water (see page 354). Dose, one to three minims.
Tinctura Nucis Vomicæ . . . . . Tincture of Nux Vomica.	Made by percolating 20 parts of nux vomica with a menstruum of 8 parts of alcohol and 1 part of water until it is exhausted. Reserve the first 90 parts, and evaporate the remainder to 10 parts and mix it with the reserved portion. Weigh a portion of the tincture, and evaporate it on a water-bath *until it ceases to lose weight*; dissolve this extract in the remainder of the tincture, and add enough of the menstruum to the tincture to make each 100 parts of tincture contain 2 parts of dry extract (see page 316). Dose, twenty minims.

IGNATIA. *U.S.* Ignatia. [Bean of Saint Ignatius.]

The seed of *Strychnos Ignatii* Bergius (Nat. Ord. *Loganiaceæ*).

Ignatia contains strychnine and brucine combined with igasuric acid, gum, resin, extractive, fixed oil, bassorin, etc. Ignatia generally yields a larger proportion of the poisonous alkaloids than nux vomica. It is tonic and very poisonous. Dose, one-half to one grain.

Officinal Preparations.

Abstractum Ignatiæ . Abstract of Ignatia.	Made with a menstruum of 8 parts of alcohol and 1 part of water: each grain represents two grains of ignatia (see page 392). Dose, one-half grain.
Tinctura Ignatiæ . . Tincture of Ignatia.	Made by assay like tincture of nux vomica (see preceding article), with this exception, that each 100 parts contain 1 part of dry extract (see page 313). Dose, twenty minims.

STRYCHNINA. *U.S.* **Strychnine.** [STRYCHNIA, Pharm. 1870.]

$C_{21}H_{22}N_2O_2$; 334.

An alkaloid prepared from Nux Vomica or Ignatia, and also occurring in other plants of the Nat. Ord. *Loganiaceæ.*

Preparation.—Strychnine may be made by the process formerly officinal, as follows:

Take of Nux Vomica, rasped, 48 oz. troy; Lime, in fine powder, 6 oz. troy; Hydrochloric Acid, 3½ oz. troy; Alcohol, Diluted Alcohol, Diluted Sulphuric Acid, Water of Ammonia, Purified Animal Charcoal, Water, each, a sufficient quantity. Macerate the Nux Vomica for twenty-four hours in 16 pints of water, acidulated with one-third of the Hydrochloric Acid; then boil for two hours, and strain with expression through a strong muslin bag. Boil the residue twice successively in the same quantity of acidulated Water, each time straining as before. Mix the decoctions and evaporate to the consistence of thin syrup; then add the Lime previously mixed with a pint of Water, and boil for ten minutes, frequently stirring. Pour the whole into a double muslin bag, and, having thoroughly washed the precipitate, press, dry, and powder it. Treat the powder repeatedly with Diluted Alcohol, in order to remove the brucine, until the washings are but faintly reddened by nitric acid. Then boil it repeatedly with Alcohol until deprived of its bitterness, mix the several tinctures, and distil off the Alcohol by means of a water-bath. Having washed the residue, mix it with a pint of Water, and, applying a gentle heat, drop in enough Diluted Sulphuric Acid to neutralize and dissolve the alkaloid. Then add Purified Animal Charcoal, and, having boiled the mixture for a few minutes, filter, evaporate, and set aside to crystallize. Dissolve the crystals in Water, and add sufficient Water of Ammonia to precipitate the Strychnine. Lastly, dry this on bibulous paper, and keep it in a well-stopped bottle.

In this process strychnine hydrochlorate is formed: this is decomposed by lime, and the strychnine is dissolved out of the excess of lime with boiling alcohol (the brucine having been previously removed by treatment with diluted alcohol), the alcoholic solution is evaporated, and sulphuric acid added to dissolve the alkaloid; the solution is decolorized and evaporated to crystallize. The crystals of strychnine sulphate are dissolved and strychnine precipitated by adding water of ammonia.

Strychnina. *U.S.*	ODOR, TASTE, AND REACTION.	SOLUBILITY.		
		Water.	Alcohol.	Other Solvents.
Colorless, octahedral or prismatic crystals, or a white, crystalline powder, permanent in the air. When heated to about 312° C. (594° F.), Strychnine melts, but is previously decomposed; at a red heat it is wholly dissipated.	Odorless; intensely bitter taste, which is still perceptible in a highly dilute (1 in 700,000) solution; alkaline reaction.	Cold. 6700 parts. Boiling. 2500 parts.	Cold. 110 parts. Boiling. 12 parts.	Soluble in 6 parts of chloroform, but almost insoluble in ether or absolute alcohol.

Tests for Identity.	Impurities.	Test for Impurities.
On adding to a few drops of cold concentrated sulphuric acid one drop of a solution of Strychnine, or of any of its salts, and then a small crystal of bichromate of potassium, a deep blue color makes its appearance, rapidly passing into violet, then cherry-red, and fades after some time.	More than traces of Brucine.	Strychnine should not be reddened at all, or at most but very faintly, by nitric acid.

Uses.—Strychnine is tonic in doses of one-sixtieth of a grain. It may sometimes be given in doses of one-twentieth of a grain.

STRYCHNINÆ SULPHAS. *U. S.* Sulphate of Strychnine.

$(C_{21}H_{22}N_2O_2)_2H_2SO_4.7H_2O$; 892. [Strychniæ Sulphas, Pharm. 1870.]

Preparation.—This salt is prepared during the process for making strychnine. (See preceding article.)

Strychninæ Sulphas. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Colorless, or white, shining, prismatic crystals, efflorescent in dry air. When heated to about 135° C. (275° F.), the salt melts, and loses 14.1 per cent. of its weight (water of crystallization); at a red heat it is completely dissipated.	Odorless; intensely bitter taste, which is still perceptible in a highly dilute (1 in 700,000) solution; neutral reaction.	Cold. 10 parts. Boiling. 2 parts.	Cold. 60 parts. Boiling. 2 parts.	Soluble in 26 parts of glycerin, but insoluble in ether.

Tests for Identity.

On adding solution of potassa to the aqueous solution, a white precipitate is thrown down, which is insoluble in an excess of potassa, and which answers to the reaction of strychnine. (See Strychnina.) The aqueous solution of the salt yields, with test-solution of chloride of barium, a white precipitate insoluble in hydrochloric acid.

Uses.—Strychnine sulphate is more useful, medicinally, than strychnine only because it is much more soluble. The dose is the same,—one-sixtieth to one-twentieth of a grain.

GELSEMIUM. *U. S.* Gelsemium. [Yellow Jasmine.]

The rhizome and rootlets of *Gelsemium sempervirens* Aiton (Nat. Ord. *Loganiaceæ*).

Gelsemium contains *gelsemine*, $C_{11}H_{12}NO_2$, gelseminic acid, volatile oil, starch, resin, fat, coloring-matter, etc. Alcohol is the best solvent for its active principles. It is used as an antispasmodic and sedative. Dose, three grains.

Officinal Preparations.

Extractum Gelsemii Fluidum (Fluid Extract of Gelsemium). Made with alcohol (see page 346). Dose, two to three minims.

Tinctura Gelsemii (Tincture of Gelsemium). Made by percolating 15 parts of gelsemium with alcohol until 100 parts are obtained (see page 312). Dose, ten to twenty minims.

PHYSOSTIGMA. *U. S.* Physostigma. [Calabar Bean.]

The seed of *Physostigma venenosum* Balfour (Nat. Ord. *Leguminosæ*, *Papilionaceæ*).

Physostigma contains *physostigmine*, or *eserine*, $C_{15}H_{21}N_3O_2$, as it is more frequently called. This alkaloid is amorphous and without taste,

soluble in water, but more soluble in alcohol, ether, chloroform, carbon disulphide, and benzol. It also contains *calabarine*, an alkaloid derived from eserine, with a neutral principle, *physosterin*, starch, protein compounds, mucilage, etc.

Physostigma is sedative, and acts as a powerful poison, contracting the pupil of the eye. Dose, one to three grains.

Officinal Preparations.

Extractum Physostigmatis . Extract of Physostigma.	Made with alcohol (see page 386). Dose, one-eighth of a grain.
Tinctura Physostigmatis . . Tincture of Physostigma.	Made by percolating 10 parts of physostigma with sufficient alcohol to make 100 parts (see page 317). Dose, twenty minims.

PHYSOSTIGMINÆ SALICYLAS. *U.S.* **Salicylate of Physostigmine.**

$C_{15}H_{21}N_3O_2C_7H_6O_3$; 413.

Preparation.—This salt may be made by adding 2 parts of physostigmine to a solution of 1 part of salicylic acid in 35 parts of boiling distilled water, and allowing the salt to crystallize on cooling.

Physostigminæ Salicylas. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Alcohol.
Colorless, shining, acicular, or short, columnar crystals, gradually turning reddish when long exposed to air and light. When heated on platinum foil, the salt is completely dissipated.	Odorless; bitter taste; neutral reaction.	Cold. 130 parts. Boiling. 30 parts.	Cold. 12 parts. Boiling. Very soluble.

Tests for Identity.

The aqueous or alcoholic solution of the salt, when exposed to light for a short time, turns reddish. On adding bicarbonate of sodium to the aqueous solution, shaking with ether and evaporating the ethereal solution, an amorphous residue is obtained, having an alkaline reaction, and assuming, when dissolved for some time in water, a reddish color, which disappears on the addition of sulphurous acid, but returns again as the latter evaporates. On concentrating the aqueous solution, which has been shaken with ether, to a small bulk, and supersaturating with sulphuric acid, a bulky white precipitate is obtained which responds to the reactions of salicylic acid. (See Acidum Salicylicum.)

Uses.—The salts of physostigmine, or eserine, are used to contract the pupil of the eye. The advantage possessed by the salicylate is that it is more permanent and less liable to deliquesce. The dose for internal administration should not be more than one-twentieth of a grain.

BELLADONNÆ FOLIA. *U.S.* **Belladonna Leaves.**

The leaves of *Atropa Belladonna* Linné (Nat. Ord. *Solanaceæ*).

BELLADONNÆ RADIX. *U.S.* **Belladonna Root.**

The root of *Atropa Belladonna* Linné (Nat. Ord. *Solanaceæ*).

Belladonna owes its activity to *atropine*, $C_{17}H_{23}NO_3$, and a small quantity of *hyoscyamine:* belladonine is also present. Atropine and hyoscyamine and some of their salts are officinal. Belladonna is narcotic and poisonous: it dilates the pupil of the eye. Dose, one to two grains.

Officinal Preparations.

Leaves.

Extractum Belladonnæ Alcoholicum (Alcoholic Extract of Belladonna.) — Made with belladonna leaves and a menstruum of 2 parts of alcohol and 1 part of water, 5 per cent. of glycerin being incorporated with the finished extract (see page 379). Dose, one-fourth grain.

Tinctura Belladonnæ (Tincture of Belladonna.) — Made by percolating 15 parts of belladonna (leaves) with sufficient diluted alcohol to make 100 parts (see page 305). Dose, ten to twenty minims.

Unguentum Belladonnæ (Belladonna Ointment.) — Made by rubbing 10 parts of alcoholic extract of belladonna with 6 parts of diluted alcohol, and incorporating 84 parts of benzoinated lard. (See Unguenta.)

Root.

Abstractum Belladonnæ (Abstract of Belladonna.) — Made by adding an evaporated alcoholic fluid extract of belladonna root to sugar of milk, so that 1 grain represents 2 grains of belladonna root (see page 390). Dose, one-half to one grain.

Extractum Belladonnæ Fluidum (Fluid Extract of Belladonna.) — Made from belladonna root with alcohol (see page 337). Dose, one to two minims.

Emplastrum Belladonnæ (Belladonna Plaster.) — Made by incorporating extract of belladonna root with resin plaster. (See Emplastra.)

Linimentum Belladonnæ (Belladonna Liniment.) — Made by dissolving 5 parts of camphor in 95 parts of fluid extract of belladonna (see page 287).

ATROPINA. *U. S.* Atropine. [ATROPIA, Pharm. 1870.]

$C_{17}H_{23}NO_3$; 289.

Preparation.—This alkaloid may be prepared by adding sulphuric acid to a concentrated alcoholic tincture of the root to convert the atropine into the sulphate, distilling off the alcohol, adding water to the residuary liquid, filtering to separate oil and resin, and treating the filtrate with potassium hydrate and chloroform. By evaporating the latter, atropine is obtained.

Atropina. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Colorless, or white, acicular crystals, permanent in the air. When heated to 114° C. (237.2° F.), the crystals melt, and, on ignition, are completely dissipated, emitting acrid vapors. Atropine and its salts are decomposed and rendered inert by prolonged contact with potassa or soda, and, if heated with either of them, evolve vapor of ammonia.	Odorless; bitter and acrid taste; alkaline reaction.	Cold. 600 parts. Boiling. 35 parts.	Very soluble.	Soluble in 3 parts of chloroform and in 60 parts of ether.

Tests for Identity.

With sulphuric acid Atropine yields a colorless solution, which is neither colored by nitric acid (difference from morphine), nor at once by solution of bichromate of potassium (difference from strychnine), though the latter reagent, by prolonged contact, causes the solution to turn green. On heating this green solution, diluted with a little water, to boiling, a pleasant odor, recalling that of roses and orange-flowers, is developed. The aqueous solution of Atropine, or of any of its salts, is not precipitated by test-solution of platinic chloride (difference from most other alkaloids). With chloride of gold it yields a precipitate which, when recrystallized from boiling water acidulated with hydrochloric acid, is deposited, on cooling (rendering the liquid turbid), in minute crystals, forming a dull, lustreless powder on drying (difference from hyoscyamine).

Uses.—Atropine is chiefly used to dilate the pupil of the eye: the sulphate, however, is preferred, on account of its solubility. It has the

properties of belladonna when given internally, and is narcotic. Dose, one one-hundred-and-twentieth to one-sixtieth of a grain.

ATROPINÆ SULPHAS. *U. S.* Sulphate of Atropine.

$(C_{17}H_{23}NO_3)_2H_2SO_4$; 676. [ATROPIÆ SULPHAS, Pharm. 1870.]

Preparation.—Atropine sulphate may be prepared by suspending 120 grains of atropine in 4 fl. dr. of distilled water and adding diluted sulphuric acid until the alkaloid is dissolved and the solution is neutral. The latter is then evaporated to dryness at a temperature not exceeding 37.7° C. (100° F.).

Atropinæ Sulphas. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A white, indistinctly crystalline powder, permanent in the air. When heated on platinum foil, the salt is decomposed and wholly dissipated, emitting acrid vapors.	Odorless; very bitter, nauseating taste; neutral reaction.	Cold. 0.4 part. Boiling. Very soluble.	Cold. 6.5 parts. Boiling. Very soluble.	0.3 part of absolute alcohol.

Tests for Identity.

On adding test-solution of carbonate of sodium to a concentrated aqueous solution of the salt, a white precipitate is obtained which answers to the reactions of Atropine. (See Atropina.) An aqueous solution of the salt yields, with test-solution of chloride of barium, a white precipitate insoluble in hydrochloric acid.

Uses.—The sulphate of atropine is preferred to the alkaloid for use as a mydriatic: an aqueous solution is generally employed for this purpose. The internal dose is from one one-hundred-and-twentieth to one-sixtieth of a grain.

HYOSCYAMUS. *U. S.* Hyoscyamus.

[HYOSCYAMI FOLIA, Pharm. 1870. HENBANE.]

The leaves of *Hyoscyamus niger* Linné (Nat. Ord. *Solanaceæ*), collected from plants of the second year's growth.

Hyoscyamus contains *hyoscyamine*, $C_{17}H_{23}NO_3$, *hyoscine*, $C_{17}H_{23}NO_3$, *hyoscypicrin*, $C_{27}H_{52}O_{14}$, chlorophyl, mucilage, extractive, etc. Hyoscyamus is narcotic, hypnotic, and slightly laxative. Dose, five grains. The sulphate of hyoscyamine is officinal. Hyoscine is coming into use as a narcotic and sedative.

Officinal Preparations.

Abstractum Hyoscyami . . . . . Made by adding a concentrated alcoholic fluid extract to sugar of milk: 1 grain represents 2 grains of hyoscyamus (see page 392). Dose, two to three grains.
Abstract of Hyoscyamus.

Extractum Hyoscyami Alcoholicum . Made with 2 parts of alcohol and 1 part of water (see page 383). Dose, one to two grains.
Alcoholic Extract of Hyoscyamus.

Extractum Hyoscyami Fluidum . . . Made with 3 parts of alcohol and 1 part of water (see page 349). Dose, five minims.
Fluid Extract of Hyoscyamus.

Tinctura Hyoscyami . . . . . Made by percolating 15 parts of hyoscyamus with sufficient diluted alcohol to make 100 parts (see page 313). Dose, one fluidrachm.
Tincture of Hyoscyamus.

HYOSCYAMINÆ SULPHAS. *U.S.* Sulphate of Hyoscyamine.

$(C_{17}H_{23}NO_3)_2.H_2SO_4$; 676.

Preparation.—The acidulated tincture of the seeds, deprived of their fixed oil, is evaporated and almost neutralized with soda, and then precipitated with tannin. The moist precipitate, mixed with lime, is exhausted with alcohol, the solution acidulated, concentrated, and agitated with ether to remove coloring-matter and oil. The hyoscyamine sulphate is decolorized and recrystallized.

Hyoscyaminæ Sulphas. *U.S.*	Tests for Identity.
Small golden-yellow or yellowish-white scales or crystals, or a yellowish-white, amorphous powder, deliquescent on exposure to air, odorless, having a bitter and acrid taste and a neutral reaction, very soluble in water and in alcohol. When heated on platinum foil, the salt chars and is finally completely dissipated. An aqueous solution of the salt is not precipitated by test-solution of platinic chloride.	With chloride of gold it yields a precipitate which, when recrystallized from boiling water acidulated with hydrochloric acid, is deposited, on cooling (without rendering the liquid turbid), in brilliant, lustrous, golden-yellow scales (difference from atropine). The aqueous solution yields, with test-solution of chloride of barium, a white precipitate insoluble in hydrochloric acid.

Uses.—This salt of hyoscyamine is used as a narcotic and sedative, in doses of one-sixtieth of a grain: it is largely used by alienists in controlling maniacal excitement. It is occasionally used as a mydriatic.

STRAMONII FOLIA. *U.S.* Stramonium Leaves.

The leaves of *Datura Stramonium* Linné (Nat. Ord. *Solanaceæ*).

STRAMONII SEMEN. *U.S.* Stramonium Seed.

The seed of *Datura Stramonium* Linné (Nat. Ord. *Solanaceæ*).

Stramoniun contains *daturine*, which has been proved to be a mixture of hyoscyamine and atropine: the leaves contain albumen, mucilage, and potassium nitrate. In the seeds there is found about 25 per cent. of fixed oil, with resins, mucilage, etc. Stramonium is narcotic and poisonous. Dose, two to three grains.

Officinal Preparations.

Extractum Stramonii . . . . . Extract of Stramonium.	Made with stramonium *seed* and a menstruum of diluted alcohol (see page 387). Dose, half a grain.
Extractum Stramonii Fluidum . Fluid Extract of Stramonium.	Made with stramonium *seed* and a menstruum of 3 parts of alcohol and 1 part of water (see page 362). Dose, one to two minims.
Tinctura Stramonii . . . . . Tincture of Stramonium.	Made by percolating 10 parts of stramonium *seed* with sufficient diluted alcohol to make 100 parts (see page 320). Dose, twenty minims.
Unguentum Stramonii . . . . Stramonium Ointment.	Made by rubbing 10 parts of extract of stramonium with 5 parts of water, and incorporating with 85 parts of benzoinated lard. (See Unguenta.)

DULCAMARA. *U.S.* Dulcamara. [Bittersweet.]

The young branches of *Solanum Dulcamara* Linné (Nat. Ord. *Solanaceæ*).

Dulcamara contains *solanine*, an alkaloid, and *dulcamarin*, $C_{22}H_{34}O_{10}$, a glucoside: the latter is the bitter and sweet principle. The other constituents are gum, wax, fat, resin, etc.

Officinal Preparation.

Extractum Dulcamaræ Fluidum . Made with diluted alcohol (see page 344). Dose, thirty to sixty minims.
Fluid Extract of Dulcamara.

PILOCARPUS. *U. S.* Pilocarpus. [JABORANDI.]

The leaflets of *Pilocarpus pennatifolius* Lemaire (Nat. Ord. *Rutaceæ, Xanthoxyleæ*).

Pilocarpus contains *pilocarpine*, $C_{11}H_{16}N_2O_2$, and a volatile oil consisting principally of *pilocarpene*, $C_{10}H_{16}$, a terpene. The leaves are coriaceous and difficult to powder. It is diaphoretic and sialagogue. Dose, twenty grains.

Officinal Preparation.

Extractum Pilocarpi Fluidum . Made with diluted alcohol (see page 355). Dose, fifteen to thirty minims.
Fluid Extract of Pilocarpus.

PILOCARPINÆ HYDROCHLORAS. *U. S.* Hydrochlorate of Pilocarpine.

$C_{11}H_{16}N_2O_2.HCl$; 244.4.

Preparation.—Pilocarpine is added to diluted hydrochloric acid until it is neutralized, and the solution is then concentrated and crystallized.

Pilocarpinæ Hydrochloras. *U. S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Minute, white crystals, deliquescent. When heated on platinum foil, the crystals melt, and are finally completely dissipated.	Odorless; faintly bitter taste; neutral reaction.	Very soluble.	Very soluble.	Almost insoluble in ether or chloroform.

Tests for Identity.

With concentrated sulphuric acid, the crystals yield a yellow color; with nitric acid (sp. gr. 1.400), a faintly greenish-violet tint; with sulphuric acid and chromate of potassium, an emerald-green color. If an aqueous solution of the salt is slightly acidulated, the addition of water of ammonia produces no precipitate. Solution of soda produces a cloudiness only in a concentrated solution. The aqueous solution yields, with test-solution of nitrate of silver, a white precipitate insoluble in nitric acid, but soluble in ammonia.

Uses.—Pilocarpine hydrochlorate is a diaphoretic and sialagogue, and is often used hypodermically. Dose, one-eighth to one-fourth of a grain.

COLCHICI RADIX. *U.S.* Colchicum Root.

The corm of *Colchicum autumnale* Linné (Nat. Ord. *Melanthaceæ*).

COLCHICI SEMEN. *U.S.* Colchicum Seed.

The seed of *Colchicum autumnale* Linné (Nat. Ord. *Melanthaceæ*).

The alkaloid *colchicine* is found in both the corm and seed of colchicum. It is the active principle. There are present in the root starch, gum, fat, sugar, resin, etc. In the seed a fixed oil is found in addition to the other principles. The toughness of the seeds is due to their composition and structure, being composed chiefly of horny albumen made up of cells having very thick walls and surrounded by a closely adherent testa. The seeds may be exhausted of their active principle by digesting them, without bruising or powdering them, in hot alcohol.

Officinal Preparations.

Extractum Colchici Radicis . . . . . Extract of Colchicum Root.	Made with a menstruum of 35 parts of acetic acid and 150 parts of water (see page 380). Dose, one to two grains.
Extractum Colchici Radicis Fluidum . Fluid Extract of Colchicum Root.	Made with 2 parts of alcohol and 1 part of water (see page 341). Dose, two to eight minims.
Vinum Colchici Radicis . . . . . Wine of Colchicum Root.	Made by percolating 40 parts of colchicum root with sufficient stronger white wine to make 100 parts (see page 324). Dose, ten minims.
Extractum Colchici Seminis Fluidum . Fluid Extract of Colchicum Seed.	Made with a menstruum of two parts of alcohol and 1 part of water (see page 342). Dose, two to eight minims.
Tinctura Colchici . . . . . Tincture of Colchicum.	Made by percolating 15 parts of colchicum seed with sufficient diluted alcohol to make 100 parts (see page 309). Dose, one-half fluidrachm.
Vinum Colchici Seminis . . . . . Wine of Colchicum Seed.	Made by percolating 15 parts of colchicum seed with sufficient stronger white wine to make 100 parts (see page 324). Dose, one-half fluidrachm.

VERATRUM VIRIDE. *U.S.* Veratrum Viride. [AMERICAN HELLEBORE.]

The rhizome and rootlets of *Veratrum viride* Aiton (Nat. Ord. *Melanthaceæ*).

Veratrum viride contains the alkaloids *jervine*, *veratroidine*, *pseudo-jervine*, and *rubijervine*. It was supposed for many years to owe its activity to veratrine. There are also present resins, starch, coloring-matter, etc. It is a cardiac sedative, poisonous, with emetic and diaphoretic properties. Dose, one to two grains.

Officinal Preparations.

Extractum Veratri Viridis Fluidum . Fluid Extract of Veratrum Viride.	Made with alcohol (see page 364). Dose, one to two minims.
Tinctura Veratri Viridis . . . . . Tincture of Veratrum Viride.	Made by percolating 50 parts of veratrum viride with sufficient alcohol to make 100 parts (see page 321). Dose, two to four minims.

VERATRINA. *U.S.* Veratrine.

An alkaloid, or mixture of alkaloids, prepared from the seeds of *Asagræa officinalis* Lindley (Nat. Ord. *Melanthaceæ*).

Preparation.—The seeds are exhausted with alcohol, and the alcohol recovered by distillation. The residuary liquid contains veratrine in its natural combination with veratric acid; this is diluted with water, (which precipitates the resins) and filtered; potassa or ammonia is added to the filtrate, when veratrine is precipitated. It is then redissolved, decolorized, and reprecipitated. Veratrine is used externally, in neuralgia, rheumatism, etc. It is sternutatory and very poisonous.

Veratrina. *U.S.*	Odor and Taste.	Solubility.	
		Alcohol.	Other Solvents.
A white, or grayish-white, amorphous, rarely crystalline powder, permanent in the air, of a distinctive, acrid taste, leaving a sensation of tingling and numbness on the tongue, producing constriction of the fauces, and highly irritant to the nostrils. Veratrine is very slightly soluble in cold or hot water, but imparts to it an acrid taste and a feebly alkaline reaction. In boiling water it strongly cakes together without melting. When heated, it melts; at higher temperatures it chars and is wholly dissipated.	Odorless; distinctive, acrid taste.	Cold. 3 parts. Boiling. Very soluble.	Soluble in 6 parts of ether, in 2 parts of chloroform, in 96 parts of glycerin, and in 56 parts of olive oil.

TESTS FOR IDENTITY.

With nitric acid, Veratrine forms a yellow solution, and, by contact with sulphuric acid, it first assumes a yellow color, which soon passes to reddish yellow, then to an intense scarlet, and, after a while, to violet-red. On triturating Veratrine with sulphuric acid in a glass mortar, the yellow or yellowish-red solution exhibits, by reflected light, a strong greenish-yellow fluorescence, which becomes more intense on adding more sulphuric acid. Heated with concentrated hydrochloric acid, it dissolves with a blood-red color.

Officinal Preparations.

Oleatum Veratrinæ . . Made by dissolving 2 parts of veratrine in 98 parts of oleic acid (see page 289). Used externally.
Oleate of Veratrine.

Unguentum Veratrinæ . Made by rubbing 4 parts of veratrine with 6 parts of alcohol and 96 parts of benzoinated lard. (See Unguenta.) Used externally.
Ointment of Veratrine.

CHELIDONIUM. *U.S.* Chelidonium. [CELANDINE.]

Chelidonium majus Linné (Nat. Ord. *Papaveraceæ*).

Chelidonium contains *chelerythrine*, *chelidonine*, $C_{19}H_{17}N_3O_3$, *chelidoxanthin*, and *chelidonic acid*. It is bitter and acrid. Used as a diuretic. Dose, forty grains.

SANGUINARIA. *U.S.* Sanguinaria. [BLOODROOT.]

The rhizome of *Sanguinaria canadensis* Linné (Nat. Ord. *Papaveraceæ*), collected in autumn.

Sanguinaria contains *sanguinarine*, $C_{19}H_{17}NO_4$, a colorless alkaloid, which yields bright red salts: another alkaloid is present which as yet is unnamed. It also contains malic and citric acids, starch, resins, coloring-matter, etc. The liquid preparations invariably deposit a reddish precipitate upon the sides of the bottle. It is alterative, sternutatory, stimulant, and emetic. The dose is ten grains.

Officinal Preparations.

Acetum Sanguinariæ . . . . . Made by percolating 10 parts of sanguinaria with sufficient diluted acetic acid to make 100 parts (see page 370). Dose, fifteen to thirty minims.
Vinegar of Sanguinaria.

Extractum Sanguinariæ Fluidum . Made with alcohol (see page 358). Dose, three to five minims.
Fluid Extract of Sanguinaria.

Tinctura Sanguinariæ . . . . . Made by percolating 15 parts of sanguinaria with sufficient menstruum, made by mixing 2 parts of alcohol with 1 part of water, to make 100 parts (see page 319). Dose, fifteen to thirty minims.
Tincture of Sanguinaria.

STAPHISAGRIA. *U.S.* Staphisagria. [STAVESACRE.]

The seed of *Delphinium Staphisagria* Linné (Nat. Ord. *Ranunculaceæ*).

Staphisagria contains three alkaloids, *delphinine*, *delphisine*, *delphinoidine*. It also contains *staphisain*, with fixed oil, protein compounds, mucilage, etc. The alkaloids are soluble in chloroform, fixed oils, alcohol, and ether, and an oleoresin made with benzin is a good preparation. It is used principally, externally, for killing body-vermin, and is very poisonous.

ACONITUM. *U.S.* Aconite.

The tuberous root of *Aconitum Napellus* Linné (Nat. Ord. *Ranunculaceæ*).

Aconite contains *aconitine*, $C_{33}H_{43}NO_{12}$; *pseudaconitine*, $C_{36}H_{49}NO_{11}$; *picraconitine*, $C_{31}H_{45}NO_{10}$; *aconine*, $C_{25}H_{39}NO_{11}$; *pseudaconine*, $C_{27}H_{41}NO_8$.

Aconitic acid, $H_3C_6H_3O_6$, is present, together with resins, sugar, fat, coloring-matter, etc. Aconitic acid may be produced by heating citric acid to 155° C. (311° F.). Alcohol is the best menstruum for preparations of aconite. The object of using tartaric acid in the menstruum is to aid in abstracting the aconitine: its use is unnecessary. Aconite is sedative and very poisonous. Dose, one grain. The dose of aconitine is one three-hundredth of a grain.

Officinal Preparations.

Abstractum Aconiti . . . . . Abstract of Aconite.	Made with alcohol containing a little tartaric acid (see page 390). Dose, one-half grain.
Extractum Aconiti . . . . . Extract of Aconite.	Made with alcohol containing a little tartaric acid, 5 per cent. of glycerin being added to the finished extract (see page 378). Dose, one-half grain.
Extractum Aconiti Fluidum . Fluid Extract of Aconite.	Made with alcohol containing a little tartaric acid (see page 336). Dose, one-half to one minim.
Tinctura Aconiti . . . . . Tincture of Aconite.	Made by percolating 40 parts of aconite with sufficient alcohol containing a little tartaric acid to make 100 parts (see page 304). Dose, one to two minims.

HYDRASTIS. *U. S.* Hydrastis. [GOLDEN SEAL.]

The rhizome and rootlets of *Hydrastis canadensis* Linné (Nat. Ord. *Ranunculaceæ*).

Hydrastis contains *hydrastine*, $C_{23}H_{23}NO_6$, *berberine*, $C_{20}H_{17}NO_4$, *xanthopuccine*, sugar, starch, resin, coloring-matter, etc. The salts of hydrastine are white, those of berberine are bright yellow. Hydrastis is used as an alterative and tonic, in doses of twenty to forty grains.

Officinal Preparations.

Extractum Hydrastis Fluidum . Fluid Extract of Hydrastis.	Made with 3 parts of alcohol and 1 part of water (see page 349). Dose, one to two fluidrachms.
Tinctura Hydrastis . . . . . Tincture of Hydrastis.	Made by percolating 20 parts of hydrastis with sufficient diluted alcohol to make 100 parts (see page 313). Dose, one-half to one fluidrachm.

MENISPERMUM. *U. S.* Menispermum. [CANADIAN MOONSEED.]

The rhizome and rootlets of *Menispermum canadense* Linné (Nat. Ord. *Menispermaceæ*).

Menispermum contains *menispine*, *berberine*, resin, starch, tannin, coloring-matter, etc. It is alterative and tonic, in doses of twenty to forty grains.

GRANATUM. *U. S.* Pomegranate.

The bark of the root of *Punica Granatum* Linné (Nat. Ord. *Granataceæ*).

Pomegranate contains four alkaloids, *pelletierine*, *isopelletierine*, *methylpelletierine*, *pseudopelletierine*. The latter is solid and crystallizable; the others are liquid. It also contains punico-tannic acid, $C_{20}H_{16}O_{13}$, sugar, mannit, pectin, gum, etc. Pomegranate is anthelmintic, in doses of thirty grains.

PAREIRA. *U. S.* Pareira. [PAREIRA BRAVA.]

The root of *Chondodendron tomentosum* Ruiz et Pavon (Nat. Ord. *Menispermaceæ*).

This root contains *pelosine*, or *cissampeline*. This has been proved to be identical with *buxine* and *beberine*, alkaloids obtained from Buxus sempervirens and Nectandra Rodiæi. Pareira is tonic, diuretic, and aperient. The dose is forty grains.

Officinal Preparation.

Extractum Pareiræ Fluidum . Made with diluted alcohol containing 20 per cent. of glycerin
Fluid Extract of Pareira. (see page 354). Dose, one fluidrachm.

IPECACUANHA. *U.S.* Ipecac.

The root of *Cephaëlis Ipecacuanha* A. Richard (Nat. Ord. *Rubiaceæ, Caffeæ.*)

Ipecac contains *emetine*, $C_{28}H_{40}N_2O_5$, *ipecacuanhic acid*, pectin, starch, resin, sugar, etc. It is emetic and expectorant. The dose is five to thirty grains. The apothegmatic matter which is dissolved by hydro-alcoholic liquids when percolating it, is slowly precipitated when added to water or syrup. It may be separated by allowing the aqueous liquid to stand until the separation is completed, and then filtering.

Officinal Preparations.

Extractum Ipecacuanhæ Fluidum . Made by a special process to separate the apothegmatic
Fluid Extract of Ipecac. matter (see page 350). Dose, ten to thirty minims.

Trochisci Ipecacuanhæ . . . . . Each troche contains ½ grain of ipecac. (See Trochisci.)
Troches of Ipecac.

Syrupus Ipecacuanhæ . . . . . Made by adding 5 parts of fluid extract of ipecac to 95
Syrup of Ipecac. parts of syrup (see page 264). Dose, thirty minims to two fluidrachms.

Tinctura Ipecacuanhæ et Opii . . Made by evaporating 100 parts of deodorized tincture of
Tincture of Ipecac and Opium. opium to 85 parts, and adding 10 parts of fluid extract of ipecac and sufficient diluted alcohol to make 100 parts (see page 314). Dose, ten minims.

Vinum Ipecacuanhæ . . . . . Made by mixing 7 parts of fluid extract of ipecac with
Wine of Ipecac. 93 parts of stronger white wine (see page 325). Dose, one fluidrachm.

Pulvis Ipecacuanhæ et Opii . . . . Made by triturating together 10 parts of powdered
Powder of Ipecac and Opium. ipecac, 10 parts of powdered opium, and 80 parts of powdered sugar of milk. (See Pulveres.) Dose, ten grains.

ERYTHROXYLON. *U.S.* Erythroxylon. [Coca.]

The leaves of *Erythroxylon Coca* Lamarck (Nat. Ord. *Erythroxylaceæ*).

Erythroxylon contains *cocaine*, $C_{17}H_{21}NO_4$, and *hygrine*, combined with cocatannic acid. Coca is a nervous stimulant, with diaphoretic properties. Cocaine is remarkable for its action as a local anæsthetic when applied to mucous membranes. The dose of coca is from thirty to sixty grains.

Officinal Preparation.

Extractum Erythroxyli Fluidum . Made with diluted alcohol (see page 345). Dose, one-half
Fluid Extract of Erythroxylon. to one fluidrachm.

GUARANA. *U.S.* Guarana.

A dried paste prepared from the crushed or ground seeds of *Paullinia sorbilis* Martius (Nat. Ord. *Sapindaceæ*).

Guarana contains caffeine, $C_8H_{10}N_4O_2$, and about 25 per cent. of tannin, with resin, mucilage, starch, volatile oil, saponin, etc. It is used as a nervous stimulant, in doses of thirty to sixty grains. It is effective only in comparatively large doses.

Officinal Preparation.

Extractum Guaranæ Fluidum . Made with 3 parts of alcohol and 1 part of water (see page
Fluid Extract of Guarana. 348). Dose, one to two fluidrachms.

CAFFEINA. *U.S.* Caffeine.

$C_8H_{10}N_4O_2.H_2O$; 212.

A proximate principle of feebly alkaloidal power, generally prepared from the dried leaves of *Camellia Thea* Link (Nat. Ord. *Ternstræmiaceæ*), or from the dried seeds of *Coffea arabica* Linné (Nat. Ord. *Rubiaceæ*), or from Guarana, and occurring also in other plants.

Caffeine is usually prepared from tea or coffee by precipitating a decoction with lead acetate, removing the excess of lead from the filtrate by hydrosulphuric acid, adding water of ammonia, evaporating, and recrystallizing.

Caffeina. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
Colorless, soft, and flexible crystals, generally quite long, and of a silky lustre, permanent in the air.	Odorless; bitter taste; neutral reaction.	Cold. 75 parts. Boiling. 9.5 parts.	Cold. 35 parts. Boiling. Very soluble.	In 6 parts of chloroform, but very slightly soluble in ether or in disulphide of carbon.

Tests for Identity.	Impurities.	Tests for Impurities.
When heated to 100° C. (212° F.), the crystals lose 8.49 per cent. in weight (of water of crystallization); and when heated on platinum foil, they are completely volatilized without carbonizing. On heating Caffeine with chlorine water, or treating it with concentrated nitric acid, it is decomposed; on evaporating afterwards, at a gentle heat, a yellow mass is left, which, when moistened with water of ammonia, assumes a purplish color.	Other Alkaloids.	Sulphuric or nitric acid should dissolve Caffeine without color, and its aqueous solution should not be precipitated by test-solution of iodide of mercury and potassium.

Uses.—Caffeine is a nervous stimulant. It is chiefly used in nervous headaches of a certain type. The dose is from one to three grains.

CONIUM. *U.S.* Conium. [Hemlock.]

The full-grown fruit of *Conium maculatum* Linné (Nat. Ord. *Umbelliferæ*, *Campylospermæ*), gathered while yet green.

Conium contains *conine*, $C_8H_{17}N$, *conhydrine*, $C_8H_{17}NO$, and *methylconine*, $C_8H_{16}CH_3N$; there are also present a little volatile oil and fixed oil. Conine is a liquid volatile alkaloid, and contains no oxygen. Its odor resembles that of the urine of mice. It is soluble in water, alcohol, and ether. Conium is narcotic and sedative. Dose, five grains.

Officinal Preparations.

Abstractum Conii . . . . . Made by adding a concentrated alcoholic fluid extract to sugar of milk so that 1 grain represents 2 grains of conium (see page 391). Dose, two grains.
Abstract of Conium.

Extractum Conii Alcoholicum . Made with diluted alcohol containing a little diluted hydrochloric acid to fix the alkaloid: 5 per cent. of glycerin is added to the finished extract (see page 381). Dose, one-half to one grain.
Alcoholic Extract of Conium.

Extractum Conii Fluidum . . Made with diluted alcohol containing a little diluted hydrochloric acid to fix the alkaloid (see page 342). Dose, five to twenty minims.
Fluid Extract of Conium.

Tinctura Conii . . . . . Made by percolating 15 parts of conium with diluted alcohol containing a little diluted hydrochloric acid until 100 parts are obtained (see page 309). Dose, thirty minims.
Tincture of Conium.

LOBELIA. *U.S.* Lobelia.

The leaves and tops of *Lobelia inflata* Linné (Nat. Ord. *Lobeliaceæ*), collected after a portion of the capsules have become inflated.

Lobelia contains *lobeline, lobelic acid, lobelacrin,* wax, resin, gum, etc. Lobeline, the alkaloid, is liquid, and contains no oxygen. Lobelia is expectorant and emetic. Dose, ten to forty grains.

Officinal Preparations.

Acetum Lobeliæ . . . . . Made by percolating 10 parts of lobelia with sufficient diluted acetic acid to make 100 parts (see page 369). Dose, thirty minims to a fluidrachm.
Vinegar of Lobelia.

Extractum Lobeliæ Fluidum . Made with diluted alcohol (see page 352). Dose, ten to twenty minims.
Fluid Extract of Lobelia.

Tinctura Lobeliæ . . . . . Made by percolating 20 parts of lobelia with sufficient diluted alcohol to make 100 parts (see page 315). Dose, one-half to one fluidrachm.
Tincture of Lobelia.

TABACUM. *U.S.* Tobacco.

The commercial, dried leaves of *Nicotiana Tabacum* Linné (Nat. Ord. *Solanaceæ*).

Tobacco contains *nicotine*, $C_{10}H_{14}N_2$, a liquid alkaloid, which is colorless, very acrid, poisonous, and rapidly turns brown on exposure to air. It is soluble in water, alcohol, and ether. Tobacco is sedative and emetic. Dose, one to five grains.

Unofficinal Drugs containing Alkaloids.

Alstonia Constricta. Australian Fever Bark. — The bark of *A. constricta*, found in Australia. It contains *alstonine*, which is very bitter.

Aspidosperma. Quebracho. — The bark of *A. Quebracho*, found in Brazil. It contains two alkaloids, *aspidospermine* and *quebrachine*.

Baptisia. Baptisia. — The root of *B. tinctoria*, found in North America. It contains an alkaloid and *baptisin*, which is an impure resin, containing some of the alkaloid.

Berberis. Barberry Bark. — From *B. vulgaris*, found in Europe and America. It contains *berberine, oxyacanthine,* and *tannin*.

Boldus. Boldo. — The leaves of *Peumus B.*, found in Chili. It contains *boldine*, volatile oil, tannin, etc.

Caffea. Coffee. — The seeds of *C. arabica*, found in most tropical countries. It contains about 1 per cent. of *caffeine*, $C_8H_{10}N_4O_2.H_2O$, and fixed oil.

Cocculus Indicus. Fish-berries. — The fruit of *Anamirta C.*, found in the East Indies. It contains *meniespermine, picrotoxin*, etc.

Colchici Flores. Colchicum Flowers. — The flowers of *Colchicum autumnale*, found in Europe. They contain a large percentage of *colchicine*.

Coptis. Goldthread. — The plant of *C. trifolia*, found in North America. It contains a yellow crystalline alkaloid, *berberine*, and a white one named *coptine*.

Coptis Teeta. East Indian Goldthread. — The rhizome of *C. Teeta*, found in East India. It contains a very large percentage of *berberine*.

Corydalis. Turkey Corn. — The tubers of *Dicentra canadensis*, grown in North America. It contains the alkaloid *corydaline*, which is very bitter, acrid resin, etc.

Curare. Wourari. — An extract made by South American Indians from plants belonging to the genus *Strychnos*. It contains an extremely poisonous alkaloid, named *curarine*.

Delphinium. Larkspur Seed. — The seed of *D. Consolida*, found in Central Europe. It contains the poisonous alkaloid *delphinine*.

Dita. Dita Bark. — From the bark of *Alstonia scholaris*, found in the Philippine Islands. It contains $\frac{1}{50}$ per cent. of a bitter alkaloid, *ditamine*, and 2 per cent. of *ditain*, an uncrystallizable bitter substance.

Duboisia. Duboisia. — The leaves of *D. myoporoides*, found in Australia. It contains a very poisonous alkaloid, *duboisine*, which is colored reddish-brown by sulphuric acid.

Unofficinal Drugs containing Alkaloids.—(*Continued.*)

Erythrophlæum. Sassy Bark.	The bark of *E. guineense*, found in Africa. It contains the colorless alkaloid *erythrophleine*, etc.
Fumaria Officinalis. Fumitory.	The plant of *F. officinalis*, found in Europe. It contains the alkaloid *fumarine*.
Glaucium. Horn Poppy.	The plant of *G. luteum*. It contains the alkaloids *sanguinarine*, *glaucine*, and *glaucopicrine*.
Rhœas. Red Poppy.	The petals of *Papaver R.*, cultivated. They contain the alkaloid *rhœadine* and some coloring-matter.
Veratrum Album. White Veratrum.	The rhizome of *V. album*, found in Europe. It contains the alkaloids *jervine*, $C_{26}H_{37}NO_3$, *pseudojervine*, *rubijervine*, *veratralbine*, etc.

Unofficinal Alkaloids.

Aconitine, $C_{33}H_{43}NO_{12}$.	From *Aconitum Napellus*. It exists in an amorphous and crystalline form; inodorous, and of a bitter and acrid taste; sparingly soluole in water, but freely so in alcohol, ether, and chloroform. Used principally for neuralgia, in the form of an ointment. A most violent poison.
Alstonine, $C_{21}H_{20}N_2O_4$.	From the bark of *Alstonia constricta*. A brownish-yellow, amorphous powder, readily soluble in alcohol.
Aspidospermine, $C_{22}H_{30}N_2O_2$.	From the bark of *Aspidosperma Quebracho*. It is a weak base, forming amorphous salts.
Beberine, $C_{18}H_{21}NO_3$.	From the bark of *Nectandra Rodiæi*. A pale yellow, amorphous powder, of a resinous aspect, inodorless, very bitter, very slightly soluble in water, inflammable, and of an alkaline reaction.
Berberine, $C_{20}H_{17}NO_4$.	From the bark of the root of *Berberis vulgare* and others. It occurs in minute yellow crystals, has a bitter taste, is soluble in 100 parts of cold water, and insoluble in ether. Its medicinal action is similar to that of quinine. Dose, one to eight grains.
Boldine.	From the leaves of *Peumus Boldus*. It imparts to water a bitter taste, is soluble in alcohol, ether, chloroform, etc., and is colored red by nitric and sulphuric acid. The yield of alkaloid is about $\frac{1}{10}$ per cent.
Buxine.	From the bark of *Buxus sempervirens*. It is identical with the beberine of nectandra bark.
Chelerythrine.	From *Chelidonium majus*. This alkaloid is identical with sanguinarine. It is an acrid poison.
Chinoline, C_9H_7N.	See Chinoline, under coal-tar products.
Chlorogenine.	Identical with Alstonine. (See above.)
Cicutine.	From *Cicuta virosa*. A volatile alkaloid.
Cocaine (Erythroxyline), $C_{17}H_{21}NO_4$.	From the leaves of *Erythroxylon Coca*. Colorless prisms of a strong alkaline reaction, a bitter taste, producing a transient numbness upon the tongue, soluble in 700 parts of water, more soluble in alcohol and ether. It is decomposed on being heated with strong hydrochloric acid. Used largely as a local anæsthetic.
Colchicine, $C_{17}H_{19}NO_5$.	From *Colchicum autumnale*. It is colorless or yellow, amorphous, soluble in water, alcohol, and chloroform; it has a saffron-like odor and a bitter taste. Its aqueous solution is colored yellow on the addition of hydrochloric acid. The yield of alkaloid is about $\frac{1}{2}$ per cent. Used in gout, rheumatism, neuralgia, etc. Dose, one-hundredth of a grain three times a day.
Conhydrine, $C_8H_{17}NO$.	From *Conium maculatum*. It occurs in pearly, iridescent plates, which are easily fusible; odor similar to that of conine.
Conine, $C_8H_{15}N$.	From *Conium maculatum*. A volatile alkaloid, inflammable, strong alkaline reaction, a strong odor, soluble in water, alcohol, ether, chloroform, etc. Used as an antispasmodic. Dose, one-fourth of a grain.
Corydaline.	From the tubers of *Dicentra canadensis*. A white, amorphous powder; its solution has a very bitter taste.
Curarine, $C_{18}H_{28}N$.	From *Curare*. It occurs in colorless prisms having a very bitter taste. It is colored red by nitric acid.
Cytisine, $C_{20}H_{27}N_3O$.	From *Cytisus Laburnum*. It occurs in white crystals, is inodorous, and has a bitter, somewhat caustic taste, and an alkaline reaction. Soluble in water and alcohol. It is colored orange-yellow by nitric acid.
Delphinine, $C_{22}H_{35}NO_6$.	From the seed of *Delphinium Staphisagria*. It occurs in flat prisms; taste bitter, followed by persistent tingling. Nearly insoluble in water.
Duboisine.	From several species of *Duboisia*. It crystallizes in fine colorless needles. Used as a substitute for atropine.
Emetine, $C_{28}H_{40}N_2O_5$.	From *Cephaëlis Ipecacuanha*. It is a yellowish-white powder, sparingly soluble in water, but dissolves in alcohol, ether, etc. Emetine is colored bright yellow or orange by chlorinated lime. The yield of alkaloid is about 1 per cent.

Unofficinal Alkaloids.—(*Continued.*)

Fumarine. From *Fumaria officinalis.* It occurs in a white, crystalline form, is of a bitter taste, scarcely soluble in water, but soluble in alcohol.

Geissospermine, $C_{19}H_{24}N_2O_2.H_2O$. From *Geissospermum lævе.* It occurs in small white prisms, nearly insoluble in ether and water, and readily soluble in alcohol and dilute acids.

Gelsemine, $C_{11}H_{19}NO_2$. From *Gelsemium sempervirens.* It occurs in an amorphous, white powder, of a very bitter taste and an alkaline reaction, slightly soluble in cold water. It is colored red changing to purple when heated with sulphuric acid.

Glaucine. From *Glaucium luteum.* A white, crystalline powder.

Glaucopicrine. From *Glaucium luteum.* A white, crystalline powder.

Guaranine. From *Paullinia sorbilis.* Identical with caffeine.

Hydrastine, $C_{22}NH_{23}O_6$. From *Hydrastis canadensis.* It occurs in white, shining, quadrangular prisms, soluble in alcohol, ether, and chloroform, insoluble in water. By adding nitric acid to a small portion of the alkaloid a red color is produced, and a brown-red by sulphuric acid. The yield of alkaloid is about 1½ per cent.

Hygrine. From the leaves of *Erythroxylon Coca.* A volatile alkaloid, of a pale yellow color and a burning taste.

Hyoscine. Obtained from *Hyoscyamus niger* in the process for obtaining hyoscyamine, and also by boiling hyoscyamine with baryta water, when decomposition takes place, forming hyoscine and hyoscinic acid.

Jervine, $C_{30}H_{46}N_2O_3$. From *Veratrum album.* It occurs, when pure, as a white powder, tasteless, insoluble in water and ether, but soluble in alcohol and chloroform.

Kairine, $C_{10}H_{13}NO.HCl.H_2O$. The hydrochlorate of an artificial alkaloid prepared from chinoline. It occurs in commerce as a grayish or yellowish crystalline powder, having a slight phenol-like odor, and a saline, bitter, somewhat aromatic taste. Soluble in boiling water.

Lobeline. From *Lobelia inflata.* It is a volatile, yellow, somewhat aromatic liquid, having an acrid taste. Soluble in alcohol, ether, and fixed oils.

Lupinine, $C_{21}H_4.N_2O_2$. From different species of *Lupinus.* It occurs in colorless, rhombic prisms having a fruity odor and a very bitter taste.

Lupuline. From *Humulus Lupulus.* A liquid alkaloid which has a strong conine-like odor and an alkaline taste.

Menispermine, $C_{18}H_{24}N_2O_2$. From *Cocculus indicus.*

Muscarine, $C_5H_{15}NO_2$. From *Amanita muscaria.* A colorless, crystalline powder, very deliquescent, sparingly soluble in chloroform, and insoluble in ether.

Nicotine, $C_{10}H_{14}N_2$. From *Nicotiana Tabacum.* A poisonous, oily liquid. It has an unpleasant tobacco-like odor, a burning taste, and a strongly alkaline reaction.

Oxyacanthine, $C_{32}H_{46}N_2O_{11}$. From *Berberis vulgaris.* It is white, turning yellow on exposure to sunlight, having a bitter taste and an alkaline reaction. Soluble in 30 parts of boiling alcohol and in 1 part of cold alcohol, insoluble in water. Sulphuric acid colors it brown-red, turning to bright red on being heated.

Pelletierine, $C_8H_{15}NO$. From *Punica Granatum.* A dextrogyrate liquid, easily soluble in water, alcohol, and ether, and especially so in chloroform.

Pelosine. From *Chondodendron tomentosum.* It is amorphous, insoluble in water, slightly soluble in ether.

Piturine, C_8H_9N. From the leaves of *Duboisia Hopwoodii.* A colorless liquid, of a nicotine odor and an acrid taste; on exposure to light it turns yellow and brown; freely soluble in water, alcohol, etc.

Punicine. See Pelletierine.

Quebrachine, $C_{21}H_{26}N_2O_2$. From the bark of *Aspidosperma Quebracho.* It yields crystallizable salts, and is colored yellow by sunlight.

Sanguinarine, $C_{19}H_{17}NO_4$. From *Sanguinaria canadensis.* It occurs in white crystals having a bitter acrid taste; soluble in ether and alcohol.

Sophorine. From the seeds of *Sophora speciosa,* a poisonous alkaloid.

Sparteine, $C_{15}H_{26}N_2$. From *Sarothamnus Scoparius.* It is a colorless, transparent, oily liquid, which becomes dark on exposure, and has a slight aniline odor and a very bitter taste.

Staphisagrine, $C_{32}H_{33}NO_8$. From *Delphinium Staphisagria.* It is amorphous, very soluble in ether and in 200 parts of water.

Theine. See Caffeine.

Theobromine, $C_7H_8N_4O_2$. From *Theobroma Cacao.* It occurs in minute, colorless or white, bitter crystals; sparingly soluble in water, alcohol, and ether.

Veratroidine, $C_{61}H_{78}N_2O_{16}$. From *Veratrum viride.* It is a white powder, of a bitter taste; soluble in alcohol, ether, chloroform, etc. It is colored yellow by sulphuric acid, changing to red.

CONDENSED CHART OF THE VEGETABLE OFFI

Natural Order. Officinal Name.	Botanical Name.	Synonyme.	Part used.	Habitat.
Algæ.				
Chondrus . . .	C. crispus and C. mammilosus.	Irish Moss.	Whole plant.	North Atlantic coast.
Apocynaceæ.				
Apocynum . .	A. cannabinum.	Canadian Hemp.	Root.	United States.
Aquifoliaceæ.				
Prinos	P. verticillatus.	Black Alder.	Bark.	North America.
Araceæ.				
Calamus . . .	Acorus C.	Sweet Flag.	Rhizome.	Europe and North America.
Aristolochiaceæ.				
Serpentaria . .	Aristolochia S. and A. reticulata.	Virginia Snake-root.	Rhizome and rootlets.	United States.
Asclepiadaceæ.				
Asclepias . . .	A. tuberosa.	Pleurisy Root.	Root.	United States.
Aurantiaceæ.				
Aurantii Amari Cortex . . .	Citrus vulgaris.		Rind of fruit.	Northern India and cult.
Aurantii Dulcis Cortex . . .	Citrus Aurantium.		Rind of fruit.	Northern India and cult.
Aurantii Flores	Citrus vulgaris and C. Aurantium.		Fresh flowers.	Northern India and cult.
Limonis Cortex	Citrus Limonum.		Rind of fruit.	Northern India and cult.
Limonis Succus	Citrus Limonum.		Juice.	Northern India and cult.
Oleum Aurantii Corticis . .	Citrus vulgaris and C. Aurantium.		Volatile oil.	
Oleum Aurantii Florum . .	Citrus vulgaris and C. Aurantium.	Oil of Neroli.	Volatile oil.	
Oleum Bergamii	Citrus Bergamia.		Volatile oil.	
Oleum Limonis	Citrus Limonum.		Volatile oil.	
Berberidaceæ.				
Caulophyllum	C. thalictroides.	Blue Cohosh.	Rhizome and rootlets.	North America.
Podophyllum .	P. peltatum.	May-Apple.	Rhizome and rootlets.	North America.
Burseraceæ.				
Myrrha . . .	Balsamodendron M.		Gum-resin.	East Africa and Arabia.

CINAL DRUGS, WITH THEIR PREPARATIONS.

English Name.	Medical Properties, Dose.	Constituents.	Officinal Preparations in heavy type; those into which the Drug enters in Roman type.
Chondrus.	Demulcent.	Mucilaginous compounds, etc.	
Apocynum.	Antiperiodic, emetic; gr. v–xx.	Tannin, resin, apocynin, etc.	
Prinos.	Astringent, alterative; gr. xxx.	Tannin, resin, wax, fat, amorphous bitter principle.	
Calamus.	Stimulant; gr. xx.	Volatile oil, acorin, resin.	**Fluid Extract**, Wine of Rhubarb.
Serpentaria.	Stimulant; gr. xx.	Volatile oil, bitter principle, starch.	**Fluid Extract, Tincture**, Compound Tincture of Cinchona.
Asclepias.	Expectorant; gr. xxx.	Tannin, resins, etc.	
Bitter Orange-Peel.	Stimulant, tonic; gr. xl.	Volatile oil, hesperidin, etc.	**Fluid Extract, Tincture**, Compound Tincture of Cinchona, Compound Tincture of Gentian.
Sweet Orange-Peel.	Stimulant.	Volatile oil, hesperidin, etc.	**Syrup, Tincture.**
Orange-Flowers.	Flavoring.	Volatile oil.	**Water.**
Lemon-Peel.	Flavoring.	Volatile oil, hesperidin.	**Spirit, Syrup.**
Lemon-Juice.	Refrigerant.	Citric acid, water, etc.	**Syrup**, Mixture of Citrate of Potassium.
Oil of Orange-Peel.	Flavoring.	$C_{10}H_{16}$.	**Elixir, Spirit**, Spirit of Myrcia.
Oil of Orange-Flowers.	Flavoring.	$C_{10}H_{16}$.	Perfumed Spirit.
Oil of Bergamot.	Scent.	$C_{10}H_{16}$.	Perfumed Spirit.
Oil of Lemon.	Flavoring.	$C_{10}H_{16}$.	**Spirit**, Perfumed Spirit, Aromatic Spirit of Ammonia.
Caulophyllum.	Antispasmodic; gr. xx.	Saponin, resins.	
Podophyllum.	Cathartic; gr. xx.	Resin, starch, sugar.	**Abstract, Extract, Fluid Extract, Resin.**
Myrrh.	Stimulant, tonic; gr. xx.	Volatile oil, resin, gum, bitter principle.	**Tincture**, Compound Iron Mixture, Pills of Aloes and Myrrh, Compound Pills of Iron, Compound Pills of Galbanum, Tincture of Aloes and Myrrh, Compound Pills of Rhubarb.

Natural Order. Officinal Name.	Botanical Name.	Synonyme.	Part used.	Habitat.
Caprifoliaceæ.				
Sambucus . .	S. canadensis.	Elder.	Flowers.	North America.
Viburnum . .	V. prunifolium.	Black Haw.	Bark.	United States.
Celastraceæ.				
Euonymus . .	E. atropurpureus.	Wahoo.	Bark.	United States.
Chenopodiaceæ.				
Chenopodium .	C. ambrosioides, var. anthelminticum.	American Wormseed.	Fruit.	North America.
Oleum Chenopodii	C. ambrosioides var. anthelminticum.	Oil of American Wormseed.	Volatile oil.	
Compositæ.				
Absinthium .	Artemisia A.	Wormwood.	Leaves and tops.	Northern Asia and nat.
Anthemis . .	A. nobilis.	Chamomile.	Flower-heads.	Southern and Western Europe.
Arnicæ Flores .	A. montana.		Flower-heads.	Mts. of Europe.
Arnicæ Radix .	A. montana.		Rhizome and rootlets.	Mts. of Europe.
Calendula . .	C. officinalis.	Marigold.	Fresh herb.	S. Europe, cult.
Eupatorium .	E. perfoliatum.	Thoroughwort.	Leaves and tops.	North America.
Grindelia . . .	G. robusta.		Leaves and tops.	North America.
Inula	I. Helenium.	Elecampane.	Root.	C. and S. Europe.
Lactucarium .	Lactuca virosa.		Concrete milk-juice.	C. and S. Europe.
Lappa	L. officinalis.	Burdock.	Root.	Europe, Northern Asia.
Matricaria . .	M. Chamomilla.	German Chamomile.	Flower-heads.	Europe.
Oleum Erigerontis . . .	Erigeron canadense.	Oil of Fleabane.	Volatile oil.	
Pyrethrum . .	Anacyclus P.	Pellitory.	Root.	Mediterranean basin.
Santonica . .	Artemisia maritima.	Levant Wormseed.	Unexpanded flower-heads.	Turkestan.
Tanacetum . .	T. vulgare.		Leaves and tops.	Asia, nat.
Taraxacum . .	T. Dens-leonis.	Dandelion.	Root.	Europe, nat.
Coniferæ.				
Juniperus . .	J. communis.		Fruit.	Northern Hemisphere.
Oleum Juniperi	Juniperus communis.		Volatile oil.	
Oleum Picis Liquidæ . .	Pinus palustris.		Volatile oil.	
Oleum Sabinæ	Juniperus S.		Volatile oil.	
Oleum Succini			Volatile oil.	

English Name.	Medical Properties, Dose.	Constituents.	Officinal Preparations in heavy type; those into which the Drug enters in Roman type.
Sambucus.	Diaphoretic; gr. lx.	Volatile oil, resin, mucilage.	
Viburnum.	Diuretic; gr. lx.	Valerianic acid, resin, tannin.	**Fluid Extract.**
Euonymus.	Laxative; gr. lx.	Euonymin, asparagin, resins.	**Extract.**
Chenopodium.	Anthelmintic; gr. xx.	Volatile oil.	
Oil of Chenopodium.	Anthelmintic; ♏ v.	$C_{10}H_{16}$. $C_{10}H_{16}O$.	
Absinthium.	Tonic; gr. xxx.	Volatile oil, absinthin, tannin, etc.	Aromatic Wine.
Anthemis.	Stimulant; gr. xl.	Volatile oil, resin, etc.	
Arnica Flowers.	Vulnerary; gr. x.	Volatile oil, arnicin.	**Tincture.**
Arnica Root.	Vulnerary; gr. x.	Volatile oil, arnicin, resin.	**Extract, Fluid Extract, Tincture.**
Calendula.	Vulnerary; gr. xxx.	Trace volatile oil, calendulin, etc.	**Tincture.**
Eupatorium.	Tonic; gr. xxx.	Eupatorin, volatile oil, tannin.	**Fluid Extract.**
Grindelia.	Sedative; gr. xxx.	Volatile oil, resin.	**Fluid Extract.**
Inula.	Stimulant; gr. lx.	Helenin, inulin, acrid resin.	
Lactucarium.	Sedative; gr. iij.	Lactucin, lactucic acid, lactucerin.	**Fluid Extract.**
Lappa.	Alterative; gr. lx.	Mucilage, inulin, tannin.	
Matricaria.	Stimulant; gr. xl.	Volatile oil, anthemic acid.	
Oil of Erigeron.	Stimulant; ♏ v.	$C_{10}H_{16}$.	
Pyrethrum.	Sialagogue; gr. xl.	Resin, fixed oils, inulin.	**Tincture.**
Santonica.	Anthelmintic; gr. xx.	Volatile oil, santonin, resin.	
Tansy.	Emmenagogue; gr. xl.	Volatile oil, tanacetin, resin, tannin.	
Taraxacum.	Cholagogue; gr. lx.	Inulin, pectin, taraxacin.	**Extract, Fluid Extract.**
Juniper.	Stimulant; gr. xl.	Volatile oil, juniperin, resins.	
Oil of Juniper.	Stimulant; ♏ v.	$C_{10}H_{16}$.	Spirit, Compound Spirit of Juniper.
Oil of Tar.	Used externally.	$C_{10}H_{16}$.	
Oil of Savine.	Stimulant; ♏ ij.	$C_{10}H_{16}$.	
Oil of Amber.	Rubefacient; ♏ v.	$C_{10}H_{16}$.	

Natural Order. Officinal Name.	Botanical Name.	Synonyme.	Part used.	Habitat.
Oleum Terebinthinæ . . .	Pinus palustris and others.		Volatile oil.	
Pix Burgundica	Abies excelsa.		Prepared resin.	Europe.
Pix Canadensis	Abies canadensis.	Hemlock Pitch.	Prepared resin.	Northern United States.
Pix Liquida .	Pinus palustris and others.		Empyreumatic Oleoresin.	United States.
Resina	Pinus australis and others.	Colophony.	Residue (from distil. turp.).	United States.
Sabina	Juniperus S.		Tops.	Europe and N. America.
Terebinthina .	Pinus australis and others.		Concrete oleoresin.	United States.
Terebinthina Canadensis .	Abies balsamea.	Balsam of Fir.	Liquid oleoresin.	North America.
Thuja	T. occidentalis.	Arbor Vitæ.	Fresh tops.	North America.
Convolvulaceæ.				
Jalapa	Exogonium Purga.		Tuberous root.	Eastern Mexico.
Scammonium .	Convolvulus Scammonia.		Resinous exudation.	Western Asia.
Cornaceæ.				
Cornus	C. florida.	Dogwood.	Bark of root.	North America.
Cruciferæ.				
Oleum Sinapis Volatile (Sub-ord. Siliquosæ.)	Sinapis nigra.		Volatile oil.	
Sinapis Alba (Sub-ord. Siliquosæ.)	S. alba.		Seed.	Asia and Southern Europe.
Sinapis Nigra (Sub-ord. Siliquosæ.)	S. nigra.		Seed.	Asia and Southern Europe.
Cucurbitaceæ.				
Bryonia . . .	B. alba and B. dioica.	Bryony.	Root.	Central and Southern Europe.
Colocynthis . .	Citrullus C.		Fruit.	Southern and Western Asia.
Pepo	Cucurbita P.		Seed.	Asia and America.
Cupuliferæ.				
Castanea . . .	C. vesca.	Chestnut.	Leaves.	North America.
Galla	Quercus lusitanica, var. infectoria.		Excrescences.	Levant.
Quercus Alba .	Q. alba.		Bark.	North America.
Ericaceæ.				
Chimaphila . .	C. umbellata.	Pipsissewa.	Leaves.	Northern Continents.

English Name.	Medical Properties, Dose.	Constituents.	Officinal Preparations in heavy type; those into which the Drug enters in Roman type.
Oil of Turpentine.	Stimulant; ♏ x.	$C_{10}H_{16}$.	**Liniment, Liniment of Cantharides.**
Burgundy Pitch.	Irritant.	Volatile oil, resin.	**Plaster,** Iron Plaster, Galbanum Plaster, Opium Plaster, Pitch Plaster with Cantharides.
Canada Pitch.	Irritant.	Volatile oil, resins.	**Plaster.**
Tar.	Irritant; gr. xxx.	Pyroligneous acid, acetone, etc.	**Syrup, Ointment.**
Resin.	Mild Stimulant.	Abietic anhydride.	**Cerate, Plaster,** Cantharides Cerate, Cerate of Extract of Cantharides, Mercurial Plaster.
Savine.	Irritant; gr. v.	Volatile oil, resin, tannin.	**Fluid Extract.**
Turpentine.	Stimulant; gr. xxx.	Volatile oil, abietic anhydride.	Galbanum Plaster.
Canada Turpentine.	Stimulant.	Volatile oil, bitter principle.	Cantharides Paper, Flexible Collodion, Iron Plaster.
Thuja.	Diuretic; gr. xxx.	Volatile oil, thujin, resin, tannin.	
Jalap.	Hydragogue cathartic; gr. xx.	Resin, starch, gum.	**Abstract, Compound Powder, Resin.**
Scammony.	Hydragogue cathartic; gr. x.	Resin, gum.	**Resin.**
Cornus.	Astringent; gr. xxx.	Cornin, tannin, resin.	**Fluid Extract.**
Volatile Oil of Mustard.	Rubefacient; ♏ ½.	Sulphocyanide of allyl.	Compound Liniment of Mustard.
White Mustard.	Stimulant; gr. cxx.	Fixed oil, myrosin, sinalbin, mucilage.	
Black Mustard.	Stimulant; gr. cxx.	Fixed oil, myrosin, sinigrin, mucilage.	**Mustard Paper.**
Bryonia.	Hydragogue cathartic; gr. xx.	Bryonin.	**Tincture.**
Colocynth.	Purgative; gr. v.	Colocynthin, resin, pectin, etc.	**Extract.**
Pumpkin Seed.	Tænifuge, ʒi.	Fixed oil, proteids, starch.	
Castanea.	Tonic, astringent; gr. xxx.	Tannin, etc.	**Fluid Extract.**
Nutgall.	Astringent; gr. xv.	Tannin, gallic acid, mucilage, resin.	**Tincture, Ointment.**
White Oak.	Astringent; gr. xxx.	Tannin, pectin, resin.	
Chimaphila.	Astringent, diuretic; gr. xxx.	Arbutin, ericolin, tannin, chimaphilin.	**Fluid Extract.**

Natural Order. Officinal Name.	Botanical Name.	Synonyme.	Part used.	Habitat.
Gaultheria . .	G. procumbens.	Wintergreen.	Leaves.	United States.
Oleum Gaultheriæ	Gaultheria procumbens.	Oil of Wintergreen.	Volatile oil.	
Uva Ursi . .	Arctostaphylos Uva-ursi.	Bearberry.	Leaves.	Northern Hemisphere.
Erythroxylaceæ.				
Erythroxylon .	E. Coca.	Coca.	Leaves.	Peru.
Euphorbiaceæ.				
Cascarilla . .	Croton Eluteria.		Bark.	Bahama Islands.
Kamala . . .	Mallotus philippinensis.	Rottlera.	Glands and hairs.	Asia.
Oleum Ricini .	Ricinus communis.		Fixed oil.	India; United States.
Oleum Tiglii .	Croton Tiglium.		Fixed oil.	India; cult.
Stillingia . . .	S. sylvatica.	Queen's Root.	Root.	Southern United States.
Filicis.				
Aspidium . .	A. Filix-mas and A. marginale.	Male Fern.	Rhizome.	Europe and N. America.
Fungi.				
Ergota	Claviceps purpurea.	Ergot of Rye.	Sclerotium.	Europe and United States, upon Secale cereale.
Ustilago . . .	U. Maydis.	Corn Smut.	Whole plant.	United States, upon Zea Mays.
Gentianaceæ.				
Chirata . . .	Ophelia C.		Herb.	Northern India.
Gentiana . . .	G. lutea.		Root.	Central and Southern Europe.
Geraniaceæ.				
Geranium . .	G. maculatum.	Cranesbill.	Rhizome.	North America.
Graminaceæ.				
Amylum . . .	Triticum vulgare.		Fecula of seed.	
Maltum . . .	Hordeum distichum.		Prepared seed.	
Saccharum . .	S. officinarum.			Tropics.
Triticum . . .	T. repens.	Couch-grass.	Rhizome.	Europe, North America.
Granataceæ.				
Granatum . .	Punica G.		Bark of root.	India; cult.
Guttiferæ.				
Cambogia . .	Garcinia Hanburii		Gum-resin.	Anam and Siam.
Hamamelaceæ.				
Hamamelis . .	H. virginica.	Witchhazel.	Leaves.	North America.

English Name.	Medical Properties, Dose.	Constituents.	Officinal Preparations in heavy type; those into which the Drug enters in Roman type.
Gaultheria.	Astringent; gr. xl.	Volatile oil, tannin, arbutin, ericolin.	Compound Syrup of Sarsaparilla.
Oil of Gaultheria.	Flavoring; gr. v.	Salicylate of methyl, $CH_3.C_7H_5O_3$.	**Spirit, Troches of Morphine and Ipecac.**
Uva Ursi.	Diuretic, astringent; gr. xxx.	Tannin, arbutin, gallic acid, ericolin.	**Fluid Extract.**
Erythroxylon.	Stimulant; gr. xxx.	Cocaine, hygrine.	**Fluid Extract.**
Cascarilla.	Tonic; gr. xx.	Volatile oil, cascarillin, resin.	
Kamala.	Tænifuge; gr. lx.	Resins, rottlerin.	
Castor Oil.	Cathartic; ℥ss.	Ricinolein and palmitin.	Flexible Collodion, Compound Liniment of Mustard.
Croton Oil.	Purgative; ♏ i.	Crotonol?	
Stillingia.	Alterative; gr. xx.	Resin, fixed oil, starch.	**Fluid Extract.**
Aspidium.	Tænifuge; gr. lx.	Fixed oil, filicic acid, etc.	**Oleoresin.**
Ergot.	Parturient; gr. x.	Fixed oil, sclerotic acid, scleromucin, sclererythrin.	**Fluid Extract, Wine.**
Ustilago.	Parturient; gr. xxx.	Fixed oil, mucilage.	
Chirata.	Tonic; gr. xx.	Ophelic acid, chiratin.	**Fluid Extract, Tincture.**
Gentian.	Tonic; gr. xx.	Gentiopicrin, gentisic acid, pectin.	**Extract, Fluid Extract, Compound Tincture.**
Geranium.	Astringent; gr. xxx.	Tannin, pectin, starch.	**Fluid Extract.**
Starch.			**Iodized Starch, Glycerite.**
Malt.			**Extract.**
Sugar.			**Syrup**, etc., etc.
Triticum.	Diuretic; gr. c.	Glucose, triticin.	**Fluid Extract.**
Pomegranate.	Anthelmintic; gr. xxx.	Punico-tannic acid, pelletierine, pectin.	
Gamboge.	Hydragogue cathartic; gr. iv.	Gum, resin, cambogic acid.	Compound Cathartic Pills.
Hamamelis.	Astringent, hæmostatic; gr. lx.	Tannin, bitter principle.	**Fluid Extract.**

Natural Order. Officinal Name.	Botanical Name.	Synonyme.	Part used.	Habitat.
Styrax	Liquidambar orientalis.		Balsam.	Asia Minor.
Iridaceæ.				
Crocus	C. sativus.		Stigmas.	Western Asia.
Iris	I. versicolor.	Blue Flag.	Rhizome and rootlets.	North America.
Juglandaceæ.				
Juglans . . .	J. cinerea.	Butternut.	Inner bark of root.	North America.
Labiatæ.				
Hedeoma . . .	H. pulegioides.	Pennyroyal.	Leaves and tops.	North America.
Lavandula . .	L. vera.		Flowers.	Southern Europe, cult.
Marrubium . .	M. vulgare.	Horehound.	Leaves and tops.	Europe, nat.
Mentha Piperita	M. piperita.		Leaves and tops.	Europe and N. America.
Mentha Viridis	M. viridis.		Leaves and tops.	Europe and N. America.
Oleum Hedeomæ	Hedeoma pulegioides.	Oil of Pennyroyal.	Volatile oil.	
Oleum Lavandulæ	Lavandula vera.		Volatile oil.	
Oleum Lavandulæ Florum.	Lavandula vera.		Volatile oil.	
Oleum Menthæ Piperitæ . .	Mentha piperita.		Volatile oil.	
Oleum Menthæ Viridis . . .	Mentha viridis.		Volatile oil.	
Oleum Rosmarini	Rosmarinus officinalis.		Volatile oil.	
Oleum Thymi .	Thymus vulgaris.		Volatile oil.	
Origanum . .	O. vulgare.	Wild Marjoram.	Herb.	Europe and N. America.
Rosmarinus . .	R. officinalis.		Leaves.	Mediterranean basin, cult.
Salvia	S. officinalis.	Sage.	Leaves.	Southern Europe, cult.
Melissa . . .	M. officinalis.	Balm.	Leaves and tops.	Europe, nat.
Scutellaria . .	S. lateriflora.	Scullcap.	Herb.	North America.
Thymol . . .	Thymus vulgaris.		Stearopten.	Southern Europe, cult.
Lauraceæ.				
Camphora . .	Cinnamomum C.		Stearopten.	China and Japan.

English Name.	Medical Properties, Dose.	Constituents.	Officinal Preparations in heavy type; those into which the Drug enters in Roman type.
Storax.	Expectorant; gr. xv.	Styrol, cinnamic acid, storesin.	Compound Tincture of Benzoin.
Saffron.	Diaphoretic; gr. xx.	Volatile oil, proteids, etc.	**Tincture.**
Iris.	Alterative; gr. xv.	Resin, tannin, gum.	**Extract, Fluid Extract.**
Juglans.	Cathartic; gr. lx.	Nucin, fixed oil, tannin.	**Extract.**
Hedeoma.	Stimulant; gr. xxx.	Volatile oil.	
Lavender.	Stimulant; gr. xxx.	Volatile oil, resin, little tannin.	Aromatic Wine.
Marrubium.	Expectorant; gr. xxx.	Trace of volatile oil, marrubiin, tannin.	
Peppermint.	Stimulant; gr. xxx.	Volatile oil, trace of tannin.	**Spirit, Aromatic Wine.**
Spearmint.	Stimulant; gr. xxx.	Volatile oil, resin.	**Spirit.**
Oil of Hedeoma.	Stimulant; ♏ v.		
Oil of Lavender.	Carminative; ♏ v.	$C_{10}H_{16}$ and compound ethers.	Compound Tincture of Lavender, Tincture of Green Soap, Diachylon Ointment.
Oil of Lavender Flowers.	Scent; ♏ iij.	$C_{10}H_{16}$ and compound ethers.	**Spirit,** Perfumed Spirit, Aromatic Spirit of Ammonia.
Oil of Peppermint.	Stimulant; ♏ iij.	$C_{10}H_{18}O$, $C_{10}H_{20}O$.	**Water, Spirit, Troches,** Compound Pills of Rhubarb.
Oil of Spearmint.	Stimulant; ♏ iij.	$C_{10}H_{16}$, $C_{10}H_{14}O$.	**Water, Spirit.**
Oil of Rosemary.	Stimulant; ♏ iij.	$C_{10}H_{16}$, — $C_{10}H_{16}O$, $C_{10}H_{18}O$.	Soap Liniment, Perfumed Spirit, Compound Tincture of Lavender.
Oil of Thyme.	Stimulant; ♏ ij.	Cymene, $C_{10}H_{14}$, thymene, $C_{10}H_{16}$, thymol, $C_{10}H_{14}O$.	
Origanum.	Stimulant; gr. xxx.	Volatile oil, tannin, resin.	Aromatic Wine.
Rosemary.	Carminative; gr. xv.	Volatile oil, tannin, resin.	Aromatic Wine.
Salvia.	Astringent; gr. xx.	Volatile oil, tannin, resin.	Aromatic Wine.
Melissa.	Stimulant; gr. xxx.	Volatile oil, tannin, bitter principle.	
Scutellaria.	Antispasmodic; gr. lx.	Bitter principle.	**Fluid Extract.**
Thymol.	Antiseptic; gr. xxx.	$C_{10}H_{14}O$.	
Camphor.	Stimulant; gr. v–x.	$C_{10}H_{16}O$.	**Water, Liniment, Spirit,** Soap Liniment, Camphorated Tincture of Opium, Belladonna Liniment, Compound Liniment of Mustard, Mixture of Chloroform, Compound Powder of Morphine.

Natural Order. Officinal Name.	Botanical Name.	Synonyme.	Part used.	Habitat.
Cinnamomum	C. Zeylanicum and other species.		Inner bark of the shoots.	Ceylon and China.
Oleum Cinnamomi . . .	Cinnamomum Zeylanicum and other species.	Oil of Cassia.	Volatile oil.	
Oleum Sassafras	Sassafras officinalis.		Volatile oil.	
Sassafras . . .	S. officinalis.		Bark of root.	North America.
Sassafras Medulla	S. officinalis.		Pith.	North America.
Leguminosæ.				
Acacia . . . (Sub-ord. Mimoseæ.)	A. Verek and others.	Gum Arabic.	Gummy exudation.	Africa.
Catechu . . (Sub-ord. Mimoseæ.)	Acacia C.		Extract from wood.	India.
Cassia Fistula . . . (Sub-ord. Cæsalpinieæ.)	C. Fistula.	Purging Cassia.	Fruit.	Eastern India.
Senna . . . (Sub-ord. Cæsalpinieæ.)	Cassia acutifolia and C. elongata.		Leaflets.	Eastern and Central Africa.
Tamarindus (Sub-ord. Cæsalpinieæ.)	T. indica.		Preserved pulp of fruit.	India, West Indies.
Balsamum Peruvianum . . (Sub-ord. Papilionaceæ.)	Myroxylon Peireræ.		Balsam.	Central America.
Balsamum Tolutanum (Sub-ord. Papilionaceæ.)	Myroxylon toluifera.		Balsam.	Venezuela.
Chrysarobinum . . (Sub-ord. Papilionaceæ.)	Andira Araroba.		Principle from Goa-Powder.	Brazil.
Copaiba . . (Sub-ord. Papilionaceæ.)	Copaifera Langsdorffii.	Balsam of Copaiba.	Oleoresin.	South America.
Glycyrrhiza (Sub-ord. Papilionaceæ.)	G. glabra.	Liquorice Root.	Root.	Europe.

English Name.	Medical Properties, Dose.	Constituents.	Officinal Preparations in heavy type; those into which the Drug enters in Roman type.
Cinnamon.	Stimulant; gr. xx.	Volatile oil, tannin, mannit, sugar.	**Tincture,** Aromatic Powder, Infusion of Digitalis, Syrup of Rhubarb, Compound Tincture of Cardamom, Compound Tincture of Catechu, Compound Tincture of Lavender, Aromatic Tincture of Rhubarb, Wine of Opium.
Oil of Cinnamon.	Stimulant; ♏ ij.	Cinnamic aldehyd, C_9H_8O.	**Water, Spirit,** Aromatic Sulphuric Acid.
Oil of Sassafras.	Stimulant; ♏ v.	Safrene, $C_{10}H_{16}$; safrol, $C_{10}H_{10}O_2$.	Troches of Cubeb.
Sassafras.	Stimulant; gr. xl.	Volatile oil, tannin, sassafrid.	Compound Decoction of Sarsaparilla, Compound Fluid Extract of Sarsaparilla, Compound Syrup of Sarsaparilla.
Sassafras Pith.	Demulcent.	Mucilage.	**Mucilage.**
Acacia.	Demulcent.	Gummic acid combined with calcium, magnesium, and potassium.	**Mucilage,** Almond Mixture, Compound Mixture of Glycyrrhiza, Pills of Iodide of Iron, Pills of Phosphorus, Compound Chalk Powder, Troches of Chalk, Troches of Cubeb, Troches of Glycyrrhiza and Opium.
Catechu.	Astringent; gr. xx.	Catechutannic acid, catechin.	**Troches, Compound Tincture.**
Cassia Fistula.	Laxative; gr. lx.	Sugar, pectin.	Confection of Senna.
Senna.	Cathartic; gr. lx.	Chrysophanic acid, phæoretin, cathartic acid, sennacrol.	**Fluid Extract, Confection, Compound Infusion, Syrup,** Compound Powder of Glycyrrhiza, Compound Syrup of Sarsaparilla.
Tamarind.	Laxative; gr. lx.	Tartaric, citric, malic, and acetic acids, mostly as potassium compounds.	Confection of Senna.
Balsam of Peru.	Expectorant; ♏ xxx.	Cinnamein, resin, cinnamic and benzoic acids.	
Balsam of Tolu.	Expectorant; gr. xx.	Resins, cinnamic and benzoic acids.	**Syrup, Tincture,** Pills of Iodide of Iron, Pills of Phosphorus, Compound Tincture of Benzoin.
Chrysarobin.	Irritant; gr. xx.		**Ointment.**
Copaiba.	Stimulant; ♏ xxx.	Volatile oil, resins, copaivic acid.	**Mass.**
Glycyrrhiza.	Expectorant; gr. lx.	Glycyrrhizin, asparagin, resin, sugar.	**Fluid Extract, Pure Extract, Ammoniated Glycyrrhizin, Compound Powder,** Compound Decoction of Sarsaparilla, Compound Fluid Extract of Sarsaparilla, Mass of Mercury, Pills of Iodide of Iron, Compound Powder of Morphine, Compound Syrup of Sarsaparilla, Sweet Tincture of Rhubarb.

Natural Order. Officinal Name.	Botanical Name.	Synonyme.	Part used.	Habitat.
Sub-ord. Papilionaceæ.				
Hæmatoxylon	H. campechianum.	Logwood.	Heart-wood.	Central America.
Kino	Pterocarpus marsupium.		Inspissated juice.	East Indies.
Oleum Copaibæ	Copaifera Langsdorffii.		Volatile oil.	
Physostigma	P. venenosum.	Calabar Bean.	Seed.	Western Africa.
Resina Copaibæ	Copaifera Langsdorffii.		Residue.	
Santalum Rubrum	Pterocarpus santalinus.		Wood.	Madras, cult.
Scoparius	Sarothamnus S.	Broom.	Tops.	Asia and Europe.
Tragacantha	Astragalus gummifer and others.		Gummy exudation.	Western Asia.
Lichenes.				
Cetraria	C. islandica.	Iceland Moss.	Whole plant.	Northern Hemisphere.
Liliaceæ.				
Allium	A. sativum.		Bulb.	Europe, cult.
Aloe	A. socotrina.		Inspissated juice.	Africa.
Scilla	Urginea S.		Sliced bulb.	Mediterranean basin.
Linaceæ.				
Linum	L. usitatissimum.	Linseed.	Seed.	Southern Europe, cult.
Oleum Lini	L. usitatissimum.	Linseed Oil.	Fixed oil.	Southern Europe, cult.
Lobeliaceæ.				
Lobelia	L. inflata.		Leaves and tops.	North America.
Loganiaceæ.				
Gelsemium.	G. sempervirens.	Yellow Jasmine.	Rhizome and rootlets.	Southern United States.
Ignatia.	Strychnos Ignatii.	Bean of St. Ignatius.	Seed.	Philippine Islands.
Nux Vomica	Strychnos Nux-vomica.		Seed.	India.
Spigelia	S. marilandica.	Pinkroot.	Rhizome and rootlets.	United States.
Lycopodiaceæ.				
Lycopodium	L. clavatum and others.		Sporules.	Europe and N. America.
Magnoliaceæ.				
Illicium	I. anisatum.	Star Anise.	Fruit.	Southwestern China.
Magnolia	M. glauca, acuminata, and tripetala.		Bark.	United States.
Oleum Anisi	(See Pimpinella Anisum.) Illicium anisatum.		Volatile oil.	

English Name.	Medical Properties, Dose.	Constituents.	Officinal Preparations in heavy type; those into which the Drug enters in Roman type.
Hæmatoxylon.	Astringent; gr. xl.	Hæmatoxylin, tannin, resin.	**Extract.**
Kino.	Astringent; gr. xx.	Kinotannic acid, pyrocatechin.	**Tincture.**
Oil of Copaiba.	Stimulant; ♏ x.	$C_{15}H_{24}$.	
Physostigma.	Sedative; gr. iij.	Eserine, starch, proteids.	**Extract, Tincture.**
Resin of Copaiba.	Stimulant; gr. x.	Copaivic acid.	
Red Saunders.	Coloring; gr. lx.	Santalic acid, santal.	Compound Tincture of Lavender.
Scoparius.	Diuretic; gr. x.	Volatile oil, scoparin, sparteine.	
Tragacanth.	Demulcent.	Traganthin, starch.	**Mucilage,** Troches of Tannic Acid, Troches of Chloride of Ammonium, Troches of Catechu, Troches of Ipecacuanha, Troches of Krameria, Troches of Chlorate of Potassium, Troches of Santoninate of Sodium, Troches of Ginger.
Cetraria.	Demulcent; gr. xl.	Lichenin, cetraric acid.	**Decoction.**
Garlic.	Stimulant; gr. lx.	Mucilage, volatile oil.	**Syrup.**
Aloes.	Laxative; gr. xv.	Aloin, resin, little volatile oil.	**Purified Aloes, Aqueous Extract,** Compound Extract of Colocynth.
Squill.	Expectorant; gr. ij.	Scillipicrin, scillitoxin, scillin, sinistrin.	**Vinegar, Fluid Extract, Tincture,** Compound Syrup of Squill.
Flaxseed.	Demulcent; gr. lx.	Fixed oil, mucilage.	
Oil of Flaxseed.	Cathartic; ʒi.	Linolein, palmitin, myristin.	
Lobelia.	Emetic; gr. x.	Lobeline, etc.	**Vinegar, Fluid Extract, Tincture.**
Gelsemium.	Antispasmodic; gr. iij.	Volatile oil, gelsemine.	**Fluid Extract, Tincture.**
Ignatia.	Tonic; gr. i.	Strychnine, brucine.	**Abstract, Tincture.**
Nux Vomica.	Tonic; gr. ij.	Strychnine, brucine, proteids.	**Abstract, Extract, Fluid Extract, Tincture.**
Spigelia.	Anthelmintic; gr. lx.	Volatile oil, bitter principle.	**Fluid Extract.**
Lycopodium.	Used externally.	Fixed oil.	
Illicium.	Stimulant; gr. xx.	Volatile oil, resin, fat.	
Magnolia.	Diaphoretic; gr. xxx.	Tannin, magnolin.	
Oil of Anise.	Stimulant; ♏ ij.	$C_{10}H_{18}$ and anethol, $C_{10}H_{12}O$.	**Water, Spirit,** Camphorated Tincture of Opium, Troches of Glycyrrhiza and Opium.

Natural Order. Officinal Name.	Botanical Name.	Synonyme.	Part used.	Habitat.
Malvaceæ.				
Althæa	A. officinalis.	Marshmallow.	Root.	Europe, nat.
Gossypii Radicis Cortex .	G. herbaceum and others.		Bark of root.	Asia, Africa, cult.
Gossypium . .	G. herbaceum and others.	Purified cotton, Absorbent cotton.	Hairs of seed.	Tropics.
Oleum Gossypii Seminis . .	G. herbaceum and others.		Fixed oil.	Tropics.
Melanthaceæ.				
Colchici Radix	C. autumnale.		Corm.	Southern and Central Europe.
Colchici Semen	C. autumnale.		Seed.	Southern and Central Europe.
Veratrum Viride	V. viride.	American Hellebore.	Rhizome and rootlets.	North America.
Meliaceæ.				
Azedarach . .	Melia A.		Bark of root.	China, cult.
Menispermaceæ.				
Calumba . . .	Jateorrhiza C.	Columbo.	Root.	Eastern Africa.
Menispermum	M. canadense.	Canadian Moonseed.	Rhizome and rootlets.	North America.
Pareira . . .	Chondodendron tomentosum.	Pareira Brava.	Root.	Brazil.
Myristicaceæ.				
Macis	Myristica fragrans.		Arillus of fruit.	Molucca Islands.
Myristica . . .	M. fragrans.		Kernel of seed.	Molucca Islands.
Oleum Myristicæ	Myristica fragrans.		Volatile oil.	
Myrtaceæ.				
Caryophyllus .	Eugenia caryophyllata.		Unexpanded flowers.	Molucca Islands.
Eucalyptus . .	E. globulus.		Leaves.	Australia.
Oleum Cajuputi	Melaleuca C.		Volatile oil.	East Indian Islands.
Oleum Caryophylli . . .	Eugenia caryophyllata.		Volatile oil.	
Oleum Eucalypti	Eucalyptus globulus, E. amygdalina, and other species.		Volatile oil.	
Oleum Myrciæ	Myrcia acris.	Oil of Bay.	Volatile oil.	

English Name.	Medical Properties, Dose.	Constituents.	Officinal Preparations in heavy type; those into which the Drug enters in Roman type.
Althæa.	Demulcent; gr. lx.	Asparagin, starch.	**Syrup**, Mass of Mercury, Pills of Phosphorus.
Cotton-Root Bark.	Emmenagogue; gr. lx.	Yellow resin, fixed oil, etc.	**Fluid Extract.**
Cotton.		Cellulose, fixed oil.	Pyroxylin.
Cotton-Seed Oil.	Demulcent; ʒss.	Olein, palmitin.	Ammonia Liniment, Lime Liniment, Camphor Liniment, Liniment of Subacetate of Lead.
Colchicum Root.	Sedative, emetic; gr. v.	Colchicine, starch, resin.	**Extract, Fluid Extract, Wine.**
Colchicum Seed.	Sedative; gr. v.	Fixed oil, colchicine.	**Fluid Extract, Tincture, Wine.**
Veratrum Viride.	Cardiac sedative; gr. ij.	Jervine, veratroidine, resin.	**Fluid Extract, Tincture.**
Azedarach.	Anthelmintic; gr. xx.	Bitter resin.	
Calumba.	Tonic; gr. xx.	Columbin, berberine.	**Fluid Extract, Tincture.**
Menispermum.	Alterative; gr. xxx.	Berberine, menispine.	
Pareira.	Diuretic; gr. xl.	Pelosine.	**Fluid Extract.**
Mace.	Stimulant; gr. xv.	Volatile oil, resin.	
Nutmeg.	Stimulant; gr. xv.	Volatile oil, fixed oil, proteids.	Vinegar of Opium, Aromatic Powder, Compound Tincture of Lavender, Aromatic Tincture of Rhubarb, Troches of Chalk, Troches of Magnesia, Troches of Bicarbonate of Sodium.
Oil of Nutmeg.	Stimulant; ♏ ij.	Myristicine, $C_{10}H_{16}$, and myristicol, $C_{10}H_{14}O$.	**Spirit.**
Cloves.	Stimulant; gr. x.	Volatile oil, tannin, resin.	Compound Tincture of Lavender, Aromatic Tincture of Rhubarb, Wine of Opium.
Eucalyptus.	Febrifuge; gr. xx.	Volatile oil, tannin, resin.	**Fluid Extract.**
Oil of Cajuput.	Diaphoretic; ♏ v.	Cajuputol, $C_{10}H_{18}O$.	
Oil of Cloves.	Stimulant; ♏ iv.	$C_{10}H_{16}$, and eugenol, $C_{10}H_{12}O_2$.	
Oil of Eucalyptus.	Febrifuge; ♏ x.	$C_{10}H_{14}$, $C_{10}H_{16}$, $C_{10}H_{18}O$.	
Oil of Myrcia.	Stimulant.	$C_{10}H_{16}$ and $C_{10}H_{12}O_2$.	Spirit of Myrcia.

Natural Order. Officinal Name.	Botanical Name.	Synonyme.	Part used.	Habitat.
Oleum Pimentæ	Eugenia Pimenta.	Oil of Allspice.	Volatile oil.	
Pimenta . . .	Eugenia P.	Allspice.	Nearly ripe fruit.	Tropical America.
Oleaceæ.				
Manna	Fraxinus Ornus.		Conc. sacch. exudation.	Mediterranean basin.
Oleum Olivæ .	Olea europæa.		Fixed oil.	Southern Europe.
Orchidaceæ.				
Cypripedium .	C. pubescens and parviflorum.	Ladies' slipper.	Rhizome and rootlets.	North America.
Vanilla . . .	V. planifolia.		Fruit.	Eastern Mexico.
Papaveraceæ.				
Chelidonium .	C. majus.	Celandine.	Whole plant.	Europe, North America.
Opii Pulvis . .			Powder.	
Opium	Papaver somniferum.		Concrete milky exud.	Western Asia, cult.
Sanguinaria .	S. canadensis.	Bloodroot.	Rhizome.	North America.
Pedaliaceæ.				
Oleum Sesami	Sesamum indicum.	Benne Oil.	Fixed oil.	India.
Phytolaccaceæ.				
Phytolaccæ Bacca . . .	P. decandra.	Poke Berry.	Fruit.	North America.
Phytolaccæ Radix	P. decandra.	Poke Root.	Root.	North America.
Piperaceæ.				
Cubeba . . .	C. officinalis.		Unripe fruit.	Java, cult.
Matico	Artanthe elongata.		Leaves.	Tropical America.
Oleum Cubebæ	Cubeba officinalis.		Volatile oil.	
Piper	P. nigrum.	Black Pepper.	Unripe fruit.	India, cult.
Polygalaceæ.				
Krameria . (Sub-ord. Krameriæ)	K. triandra and tomentosa.	Rhatany.	Root.	South America.
Senega. . . (Sub-ord. Krameriæ)	Polygala S.		Root.	United States.
Polygonaceæ.				
Rheum . . .	R. officinale and others.		Root.	Western and Central China.
Rumex	R. crispus and others.	Yellow Dock.	Root.	Europe, nat.

English Name.	Medical Properties, Dose.	Constituents.	Officinal Preparations in heavy type; those into which the Drug enters in Roman type.
Oil of Pimenta.	Stimulant; ♏ iv.	$C_{10}H_{16}$ and $C_{10}H_{12}O_2$.	Spirit of Myrcia, Aromatic Spirit of Ammonia.
Pimenta.	Stimulant; gr. xx.	Volatile oil, tannin, resin.	
Manna.	Laxative; ʒi.	Mannit, fraxin, resin, glucose.	Compound Infusion of Senna.
Olive Oil.	Laxative; fʒi.	Olein, palmitin, arachin, stearin.	Camphor Cerate, Spermaceti Cerate, Cantharides Paper, Ammoniac Plaster with Mercury, Mercurial Plaster, Lead Plaster, Diachylon Ointment.
Cypripedium.	Diaphoretic; gr. xv.	Volatile oil, tannin, resins.	**Fluid Extract.**
Vanilla.	Stimulant; gr. xx.	Vanillin, fixed oil, resin, sugar.	**Tincture,** Troches of Iron.
Chelidonium.	Diuretic; gr. xl.	Chelidonine, chelerythrine.	
Powdered Opium.	Narcotic; gr. i.	Morphine, narcotine, codeine, etc.	**Denarcotized Opium, Pills, Vinegar, Tincture, Deodorized Tincture, Camphorated Tincture,** Wine, Powder of Ipecac and Opium.
Opium.	Narcotic; gr. i.	Morphine, narcotine, codeine, etc.	**Extract, Powder.**
Sanguinaria.	Alterative; gr. x.	Sanguinarine, resins, starch.	**Vinegar, Fluid Extract, Tincture.**
Oil of Sesamum.	Demulcent; fʒi.	Olein, myristin, palmitin, stearin.	
Phytolacca Berry.	Laxative.	Sugar, gum.	
Phytolacca Root.	Alterative; gr. xx.	Resin, tannin.	
Cubeb.	Stimulant; gr. xx.	Volatile oil, resin, cubebin.	**Fluid Extract, Oleoresin, Tincture.**
Matico.	Stimulant; gr. lx.	Volatile oil, artanthic acid.	**Fluid Extract, Tincture.**
Oil of Cubeb.	Stimulant; ♏ x.	$C_{10}H_{16}$—$C_{15}H_{24}$.	
Pepper.	Stimulant; gr. x.	Volatile oil, resin, piperine, fat.	**Oleoresin.**
Krameria.	Astringent; gr. xx.	Kramero-tannic acid, rhatanic red.	**Extract, Fluid Extract, Tincture.**
Senega.	Expectorant; gr. xv.	Polygalic acid, pectin, fixed oil.	**Abstract, Fluid Extract,** Compound Syrup of Squill.
Rhubarb.	Purgative, astringent; gr. x.	Chrysophan, erythroretin, emodin, phæoretin, tannin.	**Extract, Fluid Extract, Pills, Compound Pills, Compound Powder,** Syrup, **Aromatic Tincture, Sweet Tincture,** Wine, **Tincture.**
Rumex.	Alterative; gr. lx.	Tannin, chrysophanic acid.	**Fluid Extract.**

Natural Order. Officinal Name.	Botanical Name.	Synonyme.	Part used.	Habitat.
Ranunculaceæ.				
Aconitum	A. Napellus.		Tuberous root.	Europe, Asia.
Cimicifuga	C. racemosa.	Black Snakeroot.	Rhizome and rootlets.	North America.
Hydrastis	H. canadensis	Golden Seal.	Rhizome and rootlets.	North America.
Pulsatilla	Anemone P., A. pratensis, and A. patens.		Herb.	Europe.
Staphisagria	Delphinium S.	Stavesacre.	Seed.	Europe.
Rhamnaceæ.				
Frangula	Rhamnus F.	Buckthorn.	Bark.	Europe and Northern Asia.
Rosaceæ.				
Sub-ord. Amygdaleæ. Amygdala Amara	A. communis, var. amara.		Seed.	Western Asia, cult.
Amygdala Dulcis	A. communis, var. dulcis.		Seed.	Western Asia, cult.
Oleum Amygdalæ Amaræ	Amygdala communis, var. amara.		Volatile oil.	
Oleum Amygdalæ Expressum	A. communis, var. dulcis, A. communis, var. amara.		Fixed oil.	Western Asia, cult.
Prunum	Prunus domestica.		Fruit.	Western Asia, cult.
Prunus Virginiana	P. serotina, or Cerasus s.		Bark.	North America.
Sub-ord. Dryadeæ. Rubus	R. canadensis, R. villosus, R. trivialis.	Blackberry.	Bark of root.	North America.
Rubus Idæus	R. idæus.		Fruit.	Europe and Asia, cult.
Sub-ord. Pomeæ. Cydonium	C. vulgaris.	Quince Seed.	Seed.	Western Asia, cult.
Sub-ord. Roseæ. Brayera	B. anthelminticum.	Kooso.	Female inflorescence.	Abyssinia.
Oleum Rosæ	Rosa damascena.		Volatile oil.	Roumelia.
Quillaia	Q. Saponaria.	Soap Bark.	Bark.	Chili and Peru.
Rosa Centifolia	R. centifolia.		Petals.	Western Asia, cult.
Rosa Gallica	R. gallica.		Petals.	Southern Europe, cult.
Rubiaceæ.				
Sub-ord. Cinchoneæ. Cinchona	Cinchonas with 3% of salts.		Bark.	South America.
Cinchona Flava	C. Calisaya.	Calisaya Bark.	Bark of trunk.	South America.
Cinchona Rubra	C. succiruba.	Red Bark.	Bark of trunk.	South America.

English Name.	Medical Properties, Dose.	Constituents.	Officinal Preparations in heavy type; those into which the Drug enters in Roman type.
Aconite.	Sedative; gr. i.	Resin, aconitic acid, aconitine.	**Abstract, Extract, Fluid Extract, Tincture.**
Cimicifuga.	Alterative; gr. xxx.	Crystalline principle, resin, tannin.	**Fluid Extract, Tincture.**
Hydrastis.	Alterative, tonic; gr. xl.	Berberine, hydrastine, xanthopuccine.	**Fluid Extract, Tincture.**
Pulsatilla.	Irritant, diaphoretic; gr. iv.	Oily substance, anemonic acid.	
Staphisagria.	Used externally.	Delphinine, fixed oil.	
Frangula.	Laxative; gr. xx.	Frangulin, tannin, emodin.	**Fluid Extract.**
Bitter Almond.	Demulcent.	Fixed oil, proteids, amygdalin.	**Syrup.**
Sweet Almond.	Demulcent.	Fixed oil, proteids.	**Mixture, Syrup.**
Oil of Bitter Almond.	Sedative; ♏ i.	Benzaldehyd, C_7H_6O.	**Water.**
Expressed Oil of Almond.	Lenitive.	Olein, palmitin.	Ointment of Rose Water, Phosphorated Oil.
Prune.	Laxative.	Sugar, pectin, malic acid.	Confection of Senna.
Wild Cherry.	Sedative; gr. xl.	Tannin, amygdalin, emulsin.	**Fluid Extract, Infusion, Syrup.**
Rubus.	Astringent; gr. xx.	Tannin.	**Fluid Extract.**
Raspberry.	Refrigerant.	Volatile oil, pectin, glucose.	**Syrup.**
Cydonium.	Demulcent.	Mucilage.	**Mucilage.**
Brayera.	Anthelmintic; gr. lx.	Tannin, acrid resin, kosin.	**Fluid Extract, Infusion.**
Oil of Rose.	Scent.	Elæopten, stearopten.	
Quillaia.	Irritant; gr. xv.	Saponin.	
Pale Rose.	Astringent; gr. x.	Volatile oil, tannin.	**Water,** Compound Syrup of Sarsaparilla.
Red Rose.	Tonic; gr. xx.	Volatile oil, quercitrin.	**Fluid Extract, Honey, Confection,** Pills of Aloes and Mastic.
Cinchona.	Tonic; gr. xx.		**Infusion.**
Yellow Cinchona.	Tonic, antiperiodic; gr. xx.	Quinine, quinidine, cinchonine, cinchonidine, quinamine.	**Extract, Fluid Extract, Tincture.**
Red Cinchona.	Tonic, antiperiodic; gr. xx.	*Vide* Yellow cinchona.	Compound Tincture of Cinchona.

Natural Order. Officinal Name.	Botanical Name.	Synonyme.	Part used.	Habitat.
Ipecacuanha . . (Sub-ord. Cofeæ.)	Cephaëlis I.		Root.	Brazil.
Rutaceæ.				
Buchu . . (Sub-ord. Diosmeæ.)	Barosma betulina, B. crenulata, and B. serratifolia.		Leaves.	Southern Africa.
Oleum Rutæ . . (Sub-ord. Rutæ.)	Ruta graveolens.		Volatile oil.	
Pilocarpus (Sub-ord. Xanthoxyleæ.)	P. pennatifolius.	Jaborandi.	Leaflets.	Brazil.
Xanthoxylum . . (Sub-ord. Xanthoxyleæ.)	X. fraxineum and X. caroliniianum.	Prickly Ash.	Bark.	North America.
Salicaceæ.				
Salix	S. alba and others.	Willow.	Bark.	Europe, nat.
Santalaceæ.				
Oleum Santali .	Santalum album.	Oil of Sandal Wood.	Volatile oil.	
Sapindaceæ.				
Guarana . . .	Paullinia sorbilis.		Dried paste from seeds.	Northern and Western Brazil.
Sapotaceæ.				
Gutta Percha .	Isonandra Gutta.		Concrete exudation.	Malay peninsula.
Scrophulariaceæ.				
Digitalis . . .	D. purpurea.	Foxglove.	Leaves.	Europe.
Leptandra . .	L. virginica.	Culver's Root.	Rhizome and rootlets.	North America.
Simarubaceæ.				
Quassia . . .	Picræna excelsa.		Wood.	Jamaica.
Smilaceæ.				
Sarsaparilla . .	Smilax officinalis and others.		Root.	Tropical America.
Solanaceæ.				
Belladonnæ Folia . . .	Atropa B.		Leaves.	Central and Southern Europe.
Belladonnæ Radix . . .	Atropa B.		Root.	Central and Southern Europe.
Capsicum . .	C. fastigiatum.	Cayenne Pepper, African Pepper.	Fruit.	Tropical America.
Dulcamara . .	Solanum D.	Bittersweet.	Young branches.	Europe, nat.
Hyoscyamus .	H. niger.	Henbane.	Leaves.	Europe and Asia.
Stramonii Folia	Datura Stramonium.		Leaves.	Asia, nat.
Stramonii Semen . . .	Datura Stramonium.		Seed.	Asia, nat.

English Name.	Medical Properties, Dose.	Constituents.	Officinal Preparations in heavy type; those into which the Drug enters in Roman type.
Ipecac.	Expectorant; gr. v.	Emetine, ipecacuanhic acid, pectin.	**Fluid Extract, Troches,** Powder of Ipecac and Opium, Troches of Morphine and Ipecac.
Buchu.	Diuretic; gr. xx.	Volatile oil, diosphenol, resin, mucilage, rutin (?).	**Fluid Extract.**
Oil of Rue.	Stimulant; ♏ ij.	$CH_3.CO.C_9H_{19}$.	
Pilocarpus.	Sialagogue; gr. xx.	Volatile oil, pilocarpine.	**Fluid Extract.**
Xanthoxylum.	Alterative; gr. xv.	Acrid green oil, resin.	**Fluid Extract.**
Salix.	Tonic; gr. xx.	Salicin, tannin.	
Oil of Santal.	Stimulant; ♏ x.	$C_{15}H_{24}O$— $C_{15}H_{26}O$.	
Guarana.	Stimulant; gr. lx.	Caffeine, saponin.	**Fluid Extract.**
Gutta-Percha.	Used externally.	$C_{20}H_{32}$, $C_{20}H_{32}O$, $C_{20}H_{34}O_2$.	**Solution.**
Digitalis.	Sedative, cardiac stimulant; gr. ij.	Digitalin, resin, pectin.	**Abstract, Extract, Fluid Extract, Infusion, Tincture.**
Leptandra.	Alterative; gr. xxx.	Leptandrin, resin, tannin, saponin.	**Extract, Fluid Extract.**
Quassia.	Tonic; gr. xx.	Mucilage, resin, quassin.	**Extract, Fluid Extract, Tincture.**
Sarsaparilla.	Alterative; gr. xxx.	Parillin, resin, trace of volatile oil.	**Compound Decoction, Fluid Extract, Compound Fluid Extract, Compound Syrup.**
Belladonna Leaves.	Sedative; gr. ij.	Atropine, hyoscyamine, belladonine.	**Alcoholic Extract, Tincture.**
Belladonna Root.	Sedative; gr. i.	Atropine, hyoscyamine, belladonine.	**Abstract, Fluid Extract, Plaster.**
Capsicum.	Stimulant; gr. v.	Capsaicin, fixed oil.	**Fluid Extract, Oleoresin, Tincture.**
Dulcamara.	Alterative; gr. xxx.	Resin, dulcamarin.	**Fluid Extract.**
Hyoscyamus.	Narcotic; gr. v.	Hyoscyamine, hyoscine.	**Abstract, Alcoholic Extract, Fluid Extract, Tincture.**
Stramonium Leaves.	Narcotic; gr. iij.	Daturine, mucilage.	
Stramonium Seed.	Narcotic; gr. ij.	Daturine, fixed oil.	**Extract, Fluid Extract, Tincture.**

Natural Order. Officinal Name.	Botanical Name.	Synonyme.	Part used.	Habitat.
Tabacum . . .	Nicotiana T.		Dried leaves.	America.
Sterculiaceæ.				
Oleum Theobromæ . . .	Theobroma Cacao.	Butter of Cacao.	Fixed oil.	South America.
Styraceæ.				
Benzoinum . .	Styrax Benzoin.		Balsamic resin.	Sumatra.
Terebinthaceæ.				
Mastiche . . (Sub-ord. Anacardiæ.)	Pistacia Lentiscus.		Concrete res. exudation.	Mediterranean basin.
Rhus Glabra (Sub-ord. Anacardiæ.)	R. glabra.	Sumach.	Fruit.	North America.
Rhus Toxicodendron (Sub-ord. Anacardiæ.)	R. Toxicodendron and R. radicans.	Poison Ivy.	Fresh leaves.	North America.
Thymelaceæ.				
Mezereum . .	Daphne M. and others.		Bark.	Europe.
Umbelliferæ.				
Conium . (Sub-ord. Campylospermæ.)	C. maculatum.	Hemlock.	Green fruit.	Europe, nat.
Coriandrum . (Sub-ord. Cœlospermæ.)	C. sativum.		Fruit.	Europe, cult.
Oleum Coriandri (Sub-ord. Cœlospermæ.)	Coriandrum sativum.		Volatile oil.	
Ammoniacum . . (Sub-ord. Orthospermæ.)	Dorema A.		Gum-resin.	Eastern Persia.
Anisum . . (Sub-ord. Orthospermæ.)	Pimpinella A. (See Illicium Anisatum.)		Fruit.	Asia, cult.
Asafœtida . (Sub-ord. Orthospermæ.)	Ferula Narthex and F. Scorodosma.		Gum-resin.	Persia.
Carum . . (Sub-ord. Orthospermæ.)	C. Carvi.		Fruit.	Central and W. Asia, cult.
Fœniculum (Sub-ord. Orthospermæ.)	F. vulgare.		Fruit.	Southern Europe, cult.
Galbanum . (Sub-ord. Orthospermæ.)	Ferula galbaniflua.		Gum-resin.	Persia.
Oleum Anisi (Sub-ord. Orthospermæ.)	Pimpinella Anisum.		Volatile oil.	
Oleum Cari . (Sub-ord. Orthospermæ.)	Carum Carvi.		Volatile oil.	
Oleum Fœniculi . . . (Sub-ord. Orthospermæ.)	Fœniculum vulgare.		Volatile oil.	
Sumbul . . (Sub-ord. Orthospermæ.)	Ferula S.		Root.	Asia.
Urticaceæ.				
Ficus . . (Sub-ord. Artocarpeæ.)	F. Carica.		Fleshy receptacle.	Western Asia, cult.

English Name.	Medical Properties, Dose.	Constituents.	Officinal Preparations in heavy type; those into which the Drug enters in Roman type.
Tobacco.	Emetic; gr. v.	Nicotine, resin, gum.	
Oil of Theobroma.	Emollient.	Stearin, palmitin, olein.	
Benzoin.	Stimulant; gr. xxx.	Benzoic acid, cinnamic acid.	**Benzoinated Lard, Tincture, Compound Tincture.**
Mastic.	Stimulant; gr. iij.	Volatile oil, masticic acid.	Pills of Aloes and Mastic.
Rhus Glabra.	Diuretic, astringent; gr. xl.	Acid potassium and calcium malates.	**Fluid Extract.**
Rhus Toxicodendron.	Irritant; gr. v.	Toxicodendric acid, fixed oil, tannin.	
Mezereum.	Sialagogue, stimulant; gr. v.	Soft acrid resin, daphnin.	**Extract, Fluid Extract,** Compound Decoction of Sarsaparilla, Compound Fluid Extract of Sarsaparilla.
Conium.	Sedative; gr. v.	Fixed oil, coniine.	**Abstract, Extract, Fluid Extract, Tincture.**
Coriander.	Stimulant; gr. xx.	Volatile oil, fat, mucilage.	Confection of Senna.
Oil of Coriander.	Stimulant; ♏ iij.	$C_{10}H_{18}O$.	Syrup of Senna.
Ammoniac.	Stimulant; gr. xv.	Volatile oil, resin, gum.	**Mixture, Plaster,** Ammoniac Plaster with Mercury.
Anise.	Stimulant; gr. xx.	Volatile oil, fixed oil, sugar, etc.	Compound Syrup of Sarsaparilla, Sweet Tincture of Rhubarb.
Asafetida.	Nervine; gr. x.	Volatile oil, gum-resin.	**Mixture, Pills, Tincture, Plaster,** Pills of Aloes and Asafetida, Compound Pills of Galbanum.
Caraway.	Stimulant; gr. xx.	Volatile oil, resin, little tannin.	Compound Tincture of Cardamom.
Fennel.	Stimulant; gr. xx.	Volatile and fixed oil, sugar.	Compound Infusion of Senna, Compound Powder of Glycyrrhiza.
Galbanum.	Antispasmodic; gr. xv.	Volatile oil, gum-resin.	**Plaster, Compound Pills,** Asafetida Plaster.
Oil of Anise.	Stimulant; ♏ iij.	$C_{10}H_{16}$, and anethol, $C_{10}H_{12}O$.	**Water, Spirit,** Camphorated Tincture of Opium, Troches of Glycyrrhiza and Opium.
Oil of Caraway.	Stimulant; ♏ v.	Carvine, $C_{10}H_{16}$, and carvol, $C_{10}H_{14}O$.	Compound Spirit of Juniper.
Oil of Fennel.	Stimulant; ♏ v.	$C_{10}H_{16}$, and anethol, $C_{10}H_{12}O$.	**Water,** Compound Spirit of Juniper.
Sumbul.	Stimulant; gr. x.	Volatile oil, resin, valerianic acid.	**Tincture.**
Fig.	Laxative.	Akenes, cellular tissue, sugar.	Confection of Senna.

Natural Order. Officinal Name.	Botanical Name.	Synonyme.	Part used.	Habitat.
Sub-ord. Cannabineæ.				
Cannabis Americana	C. sativa.		Whole plant.	United States.
Cannabis Indica . . .	C. sativa.		Flowering tops of female plant.	Asia.
Humulus .	H. Lupulus.		Strobiles.	Europe and Asia.
Lupulinum	H. Lupulus.		Glandular powder from strobiles.	Europe and Asia.
Sub-ord. Ulmeæ.				
Ulmus . .	U. fulva.	Slippery Elm.	Inner bark.	North America.
Valerianaceæ.				
Oleum Valerianæ	Valeriana officinalis.		Volatile oil.	
Valeriana . .	V. officinalis.		Rhizome and rootlets.	Europe, nat.
Violaceæ.				
Viola Tricolor	V. tricolor.	Pansy.	Herb.	Europe, cult.
Zingiberaceæ.				
Cardamomum	Elettaria C.		Fruit.	Malabar, cult.
Zingiber . . .	Z. officinale.		Rhizome.	India, West Indies.
Zygophyllaceæ.				
Guaiaci Lignum	G. officinale and G. sanctum.		Heart-wood.	West Indies and South America.
Guaiaci Resina	G. officinale.		Resin of wood.	West Indies and South America.

English Name.	Medical Properties, Dose.	Constituents.	Officinal Preparations in heavy type; those into which the Drug enters in Roman type.
American Cannabis.	Nervine; gr. v.	Resin, cannabinine.	
Indian Cannabis.	Nervine; gr. v.	Resin, cannabinine.	**Extract, Fluid Extract, Tincture.**
Hops.	Tonic; gr. xl.	Volatile oil, resin, tannin.	**Tincture.**
Lupulin.	Tonic; gr. v.	Volatile oil, lupuline, resin.	**Fluid Extract, Oleoresin.**
Elm.	Demulcent.	Mucilage.	**Mucilage.**
Oil of Valerian.	Nervine; ♏ v.	Borneene, $C_{10}H_{16}$, borneol, $C_{10}H_{18}O$.	
Valerian.	Nervine; gr. xxx.	Valerianic, formic, and acetic acids, tannin.	**Abstract, Fluid Extract, Tincture, Ammoniated Tincture.**
Viola Tricolor.	Alterative; gr. lx.	Mucilage, salicylic acid.	
Cardamom.	Stimulant; gr. x.	Volatile and fixed oil.	**Tincture, Compound Tincture,** Aromatic Powder, Compound Extract of Colocynth, Compound Tincture of Gentian, Tincture of Rhubarb, Sweet Tincture of Rhubarb, Wine of Aloes.
Ginger.	Stimulant; gr. xv.	Volatile oil, gingerol, resin.	**Fluid Extract, Oleoresin, Tincture,** Aromatic Powder, Compound Powder of Rhubarb, Wine of Aloes.
Guaiacum Wood.	Anti-rheumatic, diaphoretic; gr. lx.	Resin, extractive.	Compound Decoction of Sarsaparilla, Compound Syrup of Sarsaparilla.
Guaiac.	Anti-rheumatic, diaphoretic; gr. xv.	Guaiacic acid, guaiac yellow.	**Tincture, Ammoniated Tincture,** Compound Pills of Antimony.

CHAPTER LXI.

PRODUCTS FROM ANIMAL SUBSTANCES.

THE animal products of pharmaceutical interest are not numerous, but some of them are very important. Their chemical composition is not very well understood.

Protein compounds are universally found in animal and vegetable substances,—indeed, are essential to all living organisms. In their chemical composition nitrogen is always a constituent, together with carbon, hydrogen, and oxygen, and often a small quantity of sulphur. Very little is definitely known of the exact composition of the protein compounds: they are usually colloids and uncrystallizable, varying in their solubilities in aqueous liquids; they are generally coagulated by heat, and on exposure to air, heat, and moisture they decompose, undergoing *putrefaction*. If warmed to 70° C. (158° F.) in contact with *Millon's reagent*, they yield a purple-red color: this reagent is made by dissolving ten grammes of mercury in twenty grammes of nitric acid (sp. gr. 1.42), diluting the solution with an equal volume of water, and decanting after allowing it to stand twenty-four hours.

The animal products of interest in pharmacy are grouped according to the *class* to which they belong, as follows: 1. Mammalia. 2. Pisces. 3. Aves. 4. Insecta. 5. Reptilia. 6. Annelida. There are no officinal products from the last two classes.

Officinal Products derived from the Class Mammalia.

ADEPS. *U.S.* Lard.

The prepared, internal fat of the abdomen of *Sus scrofa* Linné (Class, *Mammalia*; Ord. *Pachydermata*), purified by washing with water, melting, and straining.

Lard should be preserved in securely closed vessels impervious to fat.

Preparation.—The adipose matter adhering to the kidneys, mesentery, and omentum of the hog is the usual source of the best lard. This, after careful removal of the membranes and adhering flesh, should be cut into small pieces, malaxated with successive portions of cold water until this remains clear, and then heated *moderately*, in a tinned, iron, or copper vessel, over a *slow* fire, until the melted fat becomes perfectly clear and anhydrous. Lastly, it is to be strained into earthen pots, being occasionally stirred as it cools; and the pots should be securely covered with waxed or varnished paper, and kept in a cool, dry cellar.

The purification of lard, by which the "odor of the pig" is separated, is attended with considerable labor. In France this is an industry by itself, large quantities of purified lard being used in making pomades

(see page 715). The process usually consists in spreading the lard, which has been heated with a little powdered alum, strained, and cooled, upon an inclined slate or marble slab, so arranged that a stream of water can trickle on it. Whilst the water is running, the lard is thoroughly worked with a spatula, stirrer, or muller, so that a fresh surface is continually exposed to the action of the water. This tedious process is continued until the lard is *completely washed and deodorized.*

Adeps. *U. S.*	Odor, Taste, and Reaction.	Solubility.
A soft, white, unctuous solid. It melts at or near 35° C. (95° F.) to a clear, colorless liquid, and at or below 30° C. (86° F.) it is a soft solid. Sp. gr. about 0.938.	Faint odor, free from rancidity; bland taste; neutral reaction.	Entirely soluble in ether, benzin, and disulphide of carbon.

Impurities.	Tests for Impurities.
Alkalies.	Distilled water, boiled with lard, should not acquire an alkaline reaction.
Starch.	Distilled water, boiled with lard, should not be colored blue by solution of iodine.
Common Salt.	A portion of distilled water, boiled with lard, when filtered, acidulated with nitric acid, and treated with test-solution of nitrate of silver, should not yield a white precipitate soluble in ammonia.
Water.	When heated for several hours on the water-bath, under frequent stirring, lard should not diminish sensibly in weight.

Lard, like most animal fats and oils, consists of stearin, palmitin, and olein, its consistence, when pure, depending largely upon the relative proportions of these principles: olein, being the liquid principle, can readily be separated from the other two, by subjecting lard in cold weather to strong pressure, when the *olein* (*lard oil*) is pressed out, the solid residue (*stearin*) being used for various purposes, more particularly the manufacture of candles. Lard is used in pharmacy principally as a base for ointments: it needs protection from rancidity, however. (See Adeps Benzoinatus.)

ADEPS BENZOINATUS. *U. S.* **Benzoinated Lard.** [Unguentum Benzoini, Pharm. 1870.]

Benzoin, in coarse powder, 2 parts, or	140 grains.
Lard, 100 parts, or	16 oz. av.
To make 100 parts, or	16 oz. av.

Melt the Lard by means of a water-bath, and, having loosely tied the Benzoin in a piece of coarse muslin, suspend it in the melted Lard, and, stirring them together frequently, continue the heat for two hours, covering the vessel and not allowing the temperature to rise above 60° C. (140° F.). Lastly, having removed the Benzoin, strain the Lard and stir while cooling.

Certain balsamic substances, when digested with lard or fats, have the property of preventing or retarding rancidity: benzoin is most frequently used for this purpose. The temperature at which it is digested

should not exceed 60° C. (140° F.), or the agreeable vanilla-like odor of the benzoin is dissipated. The method of adding tincture of benzoin to cold lard does not produce as good a product, for it is darker in color, less fragrant, and sometimes acts as an irritant when applied in certain skin diseases.

OLEUM ADIPIS. *U.S.* Lard Oil.

A fixed oil expressed from Lard at a low temperature.

Preparation.—This oil, which consists principally of olein, is made by exposing lard to a low temperature and then pressing it powerfully in a hydraulic press. It is a colorless or pale yellowish, oily liquid, becoming opaque at or below 0° C. (32° F.), having a slightly fatty odor and a bland taste. Sp. gr. 0.900 to 0.920.

As found in commerce, it is almost *invariably adulterated with paraffin oil.* As it is largely employed as a lubricating oil, this admixture is not particularly injurious,[1] but for its principal use in pharmacy, as the base of citrine ointment, the presence of the paraffin oil prevents solidification.

SEVUM. *U.S.* Suet.

The internal fat of the abdomen of *Ovis Aries* Linné (Class, *Mammalia;* Order, *Ruminantia*), purified by melting and straining.

Suet should be kept in well-closed vessels impervious to fat. It should not be used after it has become rancid.

Preparation.—Suet is made by a process similar to that for lard. (See Adeps.)

Sevum. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Alcohol.	Other Solvents.
A white, smooth, solid fat.	Nearly inodorous, gradually becoming rancid on exposure to air; bland taste; neutral reaction.	Boiling. 44 parts.	About 60 parts of ether, and slowly soluble in 2 parts of benzin.

Test for Identity.

From its solution in benzin, kept in a stoppered flask, it slowly separates in a crystalline form on standing. It melts between 45° and 50° C. (113° and 122° F.), and congeals between 37° and 40° C. (98.6° and 104° F.).

Uses.—Suet is firmer than lard, owing to its containing a larger proportion of stearin. It is used in making mercurial and tar ointments.

PEPSINUM SACCHARATUM. *U.S.* Saccharated Pepsin.

Pepsin, the digestive principle of the gastric juice, obtained from the mucous membrane of the stomach of the hog, and mixed with powdered Sugar of Milk.

Preparation.—Pepsin is largely made by the following process of Prof. Scheffer. The mucous membrane of hogs' stomachs is macerated in water acidulated with hydrochloric acid for several days, with frequent stirring. The strained liquid, if not clear, is clarified by allowing

[1] Perfectly pure lard oil for pharmacists' use may be obtained through Washington Butcher's Sons, Philadelphia, who are manufacturers of it on a large scale, or from their agents.

it to stand for twenty-four hours, and decanting. Chloride of sodium is then thoroughly mixed with it. After several hours the floating pepsin is skimmed from the surface and put on a cotton cloth to drain, and finally submitted to strong pressure to get rid of the saline solution. This pepsin, when air-dried, is very tough, parchment-like or leathery, varying in color from a dim straw-yellow to a brownish yellow. To make *saccharated pepsin*, sugar of milk is added until a powder is obtained, ten grains of which will dissolve five hundred grains of coagulated albumen. *Purified pepsin*, or *scaly pepsin*, is made by redissolving the pepsin in acidulated water and precipitating as before, immersing the product when perfectly dry in pure water for a short time, after which it is rapidly dried, and is in the form of yellowish scales. A half-grain of this dissolved fifteen hundred grains of albumen.

Pepsinum Saccharatum. *U. S.*	Odor and Taste.	Solubility.
Saccharated Pepsin is a white powder.	Slight, but not disagreeable odor; slight, but not disagreeable taste.	It is not completely soluble in water, leaving floccules of pepsin floating in the solution, which, however, dissolve on the addition of a small quantity of hydrochloric acid.

Tests for Identity and Quantitative Test.

Strong turbidity of the acidulated solution indicates the presence of mucus, which also imparts to the Saccharated Pepsin a disagreeable odor and taste, and will eventually impart to it an ammoniacal odor.

1 part of Saccharated Pepsin, dissolved in 500 parts of water acidulated with 7.5 parts of hydrochloric acid, should digest at least 50 parts of hard-boiled egg-albumen in five or six hours at a temperature of 38° to 40° C. (100° to 104° F.).

Uses.—Saccharated pepsin is used to aid the digestion of food, and is given in dyspepsia, in doses of ten to forty grains.

LIQUOR PEPSINI. *U. S.* **Solution of Pepsin.** [Liquid Pepsin.]

	By measure.
Saccharated Pepsin, 40 parts, or	400 grains.
Hydrochloric Acid, 12 parts, or	100 minims.
Glycerin, 400 parts, or	7 fl. oz.
Water, 548 parts, or	12 fl. oz.
To make 1000 parts, or . . . about	20 fl. oz.

Dissolve the Saccharated Pepsin in the Water, previously mixed with the Hydrochloric Acid, add the Glycerin, let the mixture stand twenty-four hours, and filter.

It should be perfectly clear, of a light yellowish color and an agreeable acidulous taste. It should not become mouldy, nor acquire a disagreeable fetid odor, when kept.

Uses.—Solution of pepsin is used as a digestive, but experience has proved that it is too weak to be very effective, and that it loses its strength by keeping: as it can be prepared quickly extemporaneously, it should be made only in small quantities. A solution four times the officinal strength would be more useful. The dose is one-half to two fluidounces.

MOSCHUS. *U.S.* Musk.

The dried secretion from the preputial follicles of *Moschus moschiferus* Linné (Class, *Mammalia;* Order, *Ruminantia*).

Musk contains cholesterin, ammonia, an acid principle, wax, fat, albuminous and gelatinous principles, and an odorous matter not yet determined. It is antispasmodic and stimulant. Dose, five to fifteen grains.

Officinal Preparation.

Tinctura Moschi . Made by macerating 10 parts of musk with diluted alcohol (see page 315). Dose, thirty minims to two fluidrachms.
Tincture of Musk.

ACIDUM LACTICUM. *U.S.* Lactic Acid.

A liquid composed of 75 per cent. of absolute Lactic Acid [$HC_3H_5O_3$; 90] and 25 per cent. of Water.

Preparation.—Lactic acid may be made from sour milk, cheese, meat-juice, lactin, and from many vegetable products. Formerly it was obtained from cheese, and owing to its frequent occurrence in the decomposition of animal products it is considered here. It is now most conveniently prepared by treating cane-sugar with sulphuric acid, so as to convert it into invert sugar, then adding solution of caustic soda and heating the mixture until it ceases to precipitate Fehling's solution, showing the absence of sugar. Sulphuric acid is added, and the sodium sulphate formed is crystallized out, an addition of alcohol causing the precipitation of the remainder. The alcoholic liquid contains impure lactic acid: one-half of it is heated and zinc carbonate added until effervescence ceases; the other half of the alcoholic liquid is now added and the whole allowed to cool. Zinc lactate crystallizes out; this, by treatment with hydrosulphuric acid, yields zinc sulphide, lactic acid remaining in solution.

Acidum Lacticum. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A nearly colorless liquid. Sp. gr. 1.212.	Odorless; very acid taste; acid reaction.	Freely miscible.	Freely miscible.	Freely miscible with ether, but nearly insoluble in chloroform.

Tests for Identity and Quantitative Test.	Impurities.	Tests for Impurities.
It is not vaporized by a heat below 160° C. (320° F.); at higher temperatures it emits inflammable vapors, then chars, and is finally entirely volatilized, or leaves but a trace of residue.	Hydrochloric Acid.	When diluted with water, Lactic Acid should afford no precipitate with test-solution of nitrate of silver.
	Sulphuric Acid.	Nor with that of chloride of barium.
	Sarcolactic Acid.	Nor with that of sulphate of copper.
	Lead, Iron.	No precipitate with sulphide of ammonium after addition of excess of water of ammonia.
	Sugars.	It should not reduce warm test-solution of potassio-cupric tartrate.
To neutralize 4.5 Gm. of Lactic Acid should require 37.5 C.c. of the volumetric solution of soda.	Glycerin.	When mixed and heated with excess of hydrated zinc oxide, and extracted with absolute alcohol, the latter should not leave a sweet residue on evaporation.
	Organic Impurities.	Cold, concentrated sulphuric acid shaken with an equal volume of Lactic Acid should assume at most only a pale yellow color.

Uses.—Lactic acid is chiefly used to form the lactates, which are believed to be more easily assimilated than most salts. It is rarely prescribed alone, but may be given in doses of one to three fluidrachms, largely diluted. It is used in preparing syrup of lactophosphate of calcium.

SACCHARUM LACTIS. *U.S.* Sugar of Milk.

$C_{12}H_{22}O_{11}.H_2O$; 360.

A peculiar, crystalline sugar obtained from the whey of cow's milk by evaporation, and purified by recrystallization.

Preparation.—Sugar of milk is prepared from the whey of cow's milk. By the addition of diluted sulphuric acid and subsequent evaporation the albuminous matter is coagulated: this is filtered out and the liquid set aside to crystallize. Animal charcoal is sometimes used to decolorize the solution.

Saccharum Lactis. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Water.	Other Solvents.
White, hard, crystalline masses, yielding a white powder feeling gritty on the tongue, permanent in the air.	Odorless; faintly sweet taste; neutral reaction.	Cold. 7 parts. Boiling. 1 part.	Insoluble in alcohol, ether, or chloroform.

Test for Identity.	Impurities.	Test for Impurities.
On adding to a solution of Sugar of Milk in an equal weight of boiling water, some solution of soda, the liquid turns brownish, and, on further addition of test-solution of sulphate of copper, a brick-red precipitate separates.	Cane-Sugar.	If 1 part of Sugar of Milk be sprinkled upon 5 parts of sulphuric acid contained in a flat-bottomed capsule, the acid should acquire not more than a greenish or reddish, but no brown or brownish-black color within one hour.

Uses.—Sugar of milk is a useful diluent, and is largely used in medicine and pharmacy. The hardness of the crystals is of great assistance in securing thorough admixture of the ingredients in compound powders, by necessitating prolonged trituration.

FEL BOVIS. *U.S.* Ox Gall.

The fresh gall of *Bos Taurus* Linné (Class, *Mammalia*; Order, *Ruminantia*).

Ox gall is of complex chemical composition, the most important constituents being the sodium salts of resinous acids, or gall acids, and coloring-matters. These acids are as follows: *glycocholic acid*, $C_{26}H_{43}NO_6$, *taurocholic acid*, $C_{26}N_{45}NSO_7$, *hyoglycocholic acid*, $C_{27}H_{43}NO_5$, *hyotaurocholic acid*, $C_{27}H_{45}NSO_6$, and *chenotaurocholic acid*, $C_{29}H_{49}NSO_6$.

Ox gall is officinally described as a brownish-green or dark green, somewhat viscid liquid, having a peculiar odor, a disagreeable, bitter taste, and a neutral or faintly alkaline reaction. Sp. gr. 1.018–1.028. A mixture of 2 drops of Ox Gall and 10 C.c. of Water, when treated first with a drop of freshly prepared solution of 1 part of sugar in 4 parts of water, and afterwards with sulphuric acid, cautiously added,

until the precipitate first formed is redissolved, gradually acquires a cherry-red color, changing successively to carmine, purple, and violet.

It is used in making the two succeeding preparations.

FEL BOVIS INSPISSATUM. *U.S.* **Inspissated Ox Gall.**

Fresh Ox Gall, 100 parts, or	**20 oz. av.**
To make 15 parts, or	**3 oz. av.**

Heat the Ox Gall to a temperature not exceeding 80° C. (176° F.), strain it through muslin, and evaporate the strained liquid, on a water-bath, in a porcelain capsule, to *fifteen parts* [or 3 oz. av.].

FEL BOVIS PURIFICATUM. *U.S.* **Purified Ox Gall.**

Fresh Ox Gall, 8 parts, or	**16 oz. av.**
Alcohol, 1 part, or	**6 fl. oz.**

Evaporate the Ox Gall in a porcelain capsule, on a water-bath, to *one part* [or 5½ oz. av.], then add to it the Alcohol, agitate the mixture thoroughly, and let it stand, well covered, for twenty-four hours. Decant the clear solution, filter the remainder, and, having mixed the liquids and distilled off the Alcohol, evaporate to a pilular consistence.

The addition of Alcohol to the concentrated liquid is for the purpose of separating mucilaginous matter.

The officinal description and tests are as follows: A yellowish-green, soft solid, having a peculiar odor, and a partly sweet and partly bitter taste. It is very soluble in water and in alcohol. A solution of 1 part of Purified Ox Gall in about 100 parts of water behaves towards sugar and sulphuric acid like the solution mentioned under Ox Gall. (See Fel Bovis.) The aqueous solution of Purified Ox Gall should yield no precipitate on the addition of alcohol.

Uses.—Ox gall is not used so extensively as it was at one time. It is administered with the intention of supplying a deficiency of bile in the intestines, in certain indications. Its usefulness is questionable. The dose is ten to fifteen grains.

Officinal Products of the Class Pisces.

ICHTHYOCOLLA. *U.S.* **Isinglass.**

The swimming-bladder of *Acipenser Huso* Linné, and of other species of *Acipenser* (Class, *Pisces*; Order, *Sturiones*).

Preparation.—Russian isinglass is the kind designated by the Pharmacopœia: it is made by washing and drying the swimming-bladders or air-bags of the Russian sturgeon, by stretching them upon flat boards to dry. It is described as in separate sheets, sometimes rolled, of a horny or pearly appearance; whitish or yellowish, semi-transparent, iridescent, inodorous, insipid; almost entirely soluble in boiling water and in boiling diluted alcohol. The solution in 24 parts of boiling water forms, on cooling, a transparent jelly.

American isinglass is in flat, ribbon-like bands, having somewhat the appearance of rolled and rumpled thin manilla paper: it has a fishy odor, and is much inferior to the officinal isinglass.

Isinglass is the purest form of gelatin attainable: it is used in making court-plaster, and, owing to its forming an insoluble compound with tannin, is employed in clarifying coffee and other similar liquids.

Officinal Preparation.

Emplastrum Ichthyocollæ . Made by dissolving 10 parts of isinglass in sufficient hot water to make 120 parts, coating taffeta with one-half of the solution, then mixing the other half with 40 parts of alcohol and 1 part of glycerin, and applying it in successive layers. The reverse side of the taffeta is coated with tincture of benzoin.
Isinglass Plaster.

CETACEUM. *U.S.* Spermaceti.

A peculiar, concrete, fatty substance, obtained from *Physeter macrocephalus* Linné (Class, *Mammalia;* Order, *Cetacea*).

Preparation.—Spermaceti is made by the forcible expression of the oleaginous compound found in the head of the sperm-whale to separate the olein: the solid fat is termed *cetin.* It is officinally described as in white, somewhat translucent, slightly unctuous masses, of a scaly-crystalline fracture, a pearly lustre, becoming yellowish and rancid by exposure to air, odorless, having a mild, bland taste and a neutral reaction. Sp. gr. about 0.945. It melts near 50° C. (122° F.) and congeals near 45° C. (113° F.). It is soluble in ether, chloroform, disulphide of carbon, and boiling alcohol; but slightly soluble in cold benzin.

Spermaceti is a mixture of various fats. When recrystallized from alcohol, *cetin* is obtained, while the alcohol on evaporation deposits an oil, *cetin-elain,* which when saponified yields *cetin-elaic acid,* an acid resembling, but distinct from, oleic acid. The cetin which crystallizes out of the alcohol is essentially *cetyl palmitate,* $C_{16}H_{33}(C_{16}H_{31}O_2)$. There are small amounts of fats containing *stearic acid,* $C_{18}H_{36}O_2$, *myristic acid,* $C_{14}H_{28}O_2$, and *lauro-stearic acid,* $C_{12}H_{24}O_2$, and the alcohol radicles corresponding to these acids.

Uses.—Spermaceti is one of the solid fatty substances employed to give consistency to cerates and ointments: it is used in the well-known ointment of rose water, or cold cream.

Officinal Preparation.

Ceratum Cetacei . . Made by melting together 10 parts of spermaceti, 35 parts of white wax, and 55 parts of olive oil. (See Cerata.)
Spermaceti Cerate.

OLEUM MORRHUÆ. *U.S.* Cod Liver Oil.

A fixed oil obtained from the fresh livers of *Gadus Morrhua* Linné, or of other species of *Gadus* (Class, *Pisces;* Order, *Teleostia;* Family, *Gadida*).

Preparation.—The best method of preparing cod liver oil is to heat the livers in a wooden tank by means of low-pressure steam. The resulting mass is carefully drained,—the livers themselves containing, besides oil, a considerable portion of watery fluid, which passes off with it in the form of emulsion and separates on standing. In the case of the finest varieties, the oil, which is made only in the winter months, is drawn off by taps from the bottom of the cooking-tank, and then put into a cooling-house to freeze. The solid frozen mass is put into canvas

bags, and submitted, whilst at a low temperature, to severe pressure, whereby the pure oil is expressed. This constitutes the light oil of commerce.

Cod liver oil consists chiefly of olein. Palmitin and stearin are present in small proportions; minute traces of iodine, chlorine, bromine, phosphorus, and sulphur are found, but these are not in sufficient quantity to have any medicinal effect.

Oleum Morrhuæ. *U.S.*	Odor, Taste, and Reaction.	Solubility.	
		Alcohol.	Other Solvents.
A colorless or pale yellow, thin, oily liquid. When cooled to near 0° C. (32° F.), a white granular matter separates. Sp. gr. 0.920–0.925.	Slightly fishy odor; bland, slightly fishy taste; faintly acid reaction.	Scarcely soluble.	Readily soluble in ether; also in 2.5 parts of acetic ether.

Tests for Identity.

On the addition of sulphuric acid, the Oil acquires a violet color, soon changing to brownish red; and if 1 drop of the Oil be dissolved in 20 drops of disulphide of carbon, and the solution shaken with 1 drop of sulphuric acid, it will acquire a violet-blue tint, rapidly changing to rose-red and brownish yellow. With nitric acid the Oil yields a purple color, changing to brown.

Uses.—Cod liver oil is used as a nutrient and alterative in wasting diseases, notably phthisis. Dose, one to four fluidrachms.

Officinal Products of the Class Aves.

VITELLUS. *U.S.* Yolk of Egg.

The yolk of the egg of *Gallus Bankiva* var. *domesticus* Temminck (Class, *Aves*; Order, *Gallinæ*).

Yolk of egg contains *vitellin*, a protein compound resembling casein, albumen, fat, cholesterin, inorganic salts, coloring-matter, etc. There is also present water in the proportion of about 50 per cent. *White of egg* consists principally of albumen, with 80 per cent. of water. The inorganic salt present in largest proportion is potassium chloride.

Uses.—Yolk of egg is valuable in pharmacy as an emulsifying agent, its value lying chiefly in the fact of its being an excellent nucleus and a perfect natural emulsion. (See Mistura Chloroformi, and Emulsions, Part V.).

Officinal Preparation.

Glyceritum Vitelli . . . . 45 parts of fresh yolk of egg and 55 parts of glycerin. Mix well, and express through muslin.
Glycerite of Yolk of Egg.

Officinal Products of the Class Insecta.

CANTHARIS. *U.S.* Cantharides. [Spanish Flies.]

Cantharis vesicatoria De Geer (Class, *Insecta*; Order, *Coleoptera*).
Cantharides should be kept in well-closed vessels containing a little camphor.

Cantharides owe their blistering properties to *cantharidin*, $C_{10}H_{12}O_4$. This is a white substance, in the form of crystalline scales, of a shining

micaceous appearance, inodorous, tasteless, almost insoluble in water and in cold alcohol, but soluble in ether, chloroform, benzol, formic and glacial acetic acids, the oils, and in hot alcohol, which deposits it upon cooling. It fuses at 210° C. (410° F.), is volatilizable by heat without decomposition, and its vapor condenses in acicular crystals. The subliming point of isolated cantharidin is 100° C. (212° F.), or the temperature of boiling water. Cantharidin is believed to be the anhydride of cantharidic acid. The latter forms definite salts with bases: these may be obtained by heating cantharidin with alkaline solutions. The most satisfactory test of cantharidin is its vesicating property.

Uses.—Cantharides are aphrodisiac and poisonous: when applied externally they produce vesication.

Officinal Preparations.

Ceratum Cantharidis . . . . . Cantharides Cerate.	35 parts of cantharides, 20 parts of yellow wax, 20 parts of resin, and 25 parts of lard. Melt together the wax, resin, and lard, strain through muslin, add the cantharides, and keep the mixture in a melted state for half an hour, then stir until cold. (See Cerata.)
Ceratum Extracti Cantharidis . . Cerate of Extract of Cantharides.	Mix a specially prepared alcoholic extract of cantharides with melted resin, wax, and lard. (See Cerata.)
Charta Cantharidis . . . . . Cantharides Paper.	Mix 8 parts of white wax, 3 parts of spermaceti, 4 parts of olive oil, 1 part of Canada turpentine, 1 part of cantharides, and 10 parts of water in a tinned vessel, and boil for two hours. Strain, transfer to a shallow vessel, and pass strips of sized paper over the surface of the liquid so as to coat one side.
Collodium cum Cantharide . . . . Collodion with Cantharides.	See page 285.
Linimentum Cantharidis . . . . . Cantharides Liniment.	Made by digesting 15 parts of cantharides in oil of turpentine, to make 100 parts (see page 287).
Tinctura Cantharidis . . . . . Tincture of Cantharides.	Made by percolating 5 parts of powdered cantharides with sufficient alcohol to make 100 parts (see page 307). Dose, three to ten minims.

COCCUS. *U. S.* Cochineal.

The dried female of *Coccus cacti* Linné (Class, *Insecta;* Order, *Hemiptera*).

The odor of cochineal is faint; its taste slightly bitterish. It contains a red coloring-matter soluble in water, alcohol, and water of ammonia, slightly soluble in ether, insoluble in fixed and volatile oils. On macerating Cochineal in water, the insect swells up, but no insoluble powder should be separated.

Cochineal owes its red color to *carminic acid*, $C_{17}H_{18}O_{10}$. It contains mucilage, fat, inorganic salts, etc. Its only use in pharmacy is to impart a bright red color to various preparations, like compound tincture of cardamom, elixirs, etc.

CERA FLAVA. *U. S.* Yellow Wax.

A peculiar, concrete substance, prepared by *Apis mellifica* Linné (Class, *Insecta;* Order, *Hymenoptera*).

CERA ALBA. *U. S.* White Wax.

Yellow wax, bleached.

Preparation.—Wax is now known to be a peculiar secretion of bees. Yellow wax is obtained on the large scale by first abstracting the honey

from the combs by shaving off the ends of the cells, draining, and then placing them in centrifugals. The honey is rapidly whirled out, water is added, and the wax is thoroughly and quickly cleaned; it is then melted and strained and run into flat dishes or moulds to cool and harden.

Beeswax is a mixture of three different substances, which may be separated from one another by alcohol,—viz.: 1, *myricin*, insoluble in boiling alcohol, and consisting chiefly of myricyl palmitate, $C_{30}H_{61}(C_{16}H_{31}O_2)$, which is a compound of *palmitic acid*, $C_{16}H_{32}O_2$, and *myricyl alcohol*, $C_{30}H_{62}O$; 2, *cerotic acid*, $C_{27}H_{54}O_2$ (formerly called *cerin* when obtained only in an impure state), which is dissolved by boiling alcohol, but crystallizes out on cooling; 3, *cerolein*, which remains dissolved in the cold alcoholic liquid. This latter is probably a mixture of fatty acids, as indicated by its acid reaction to litmus paper.

Cera Flava. *U.S.*	Odor, Taste, and Reaction.	Solubility.		
		Water.	Alcohol.	Other Solvents.
A yellowish or brownish-yellow solid. It is brittle when cold, but becomes plastic by the heat of the hand. It melts at 63°–64° C. (145.4°–147.2° F.), and congeals with a smooth and level surface. Sp. gr. 0.955–0.967.	Agreeable, honey-like odor; faint, balsamic taste.	Insoluble.	Cold. Only partially soluble. Boiling. Almost completely soluble.	Soluble in 35 parts of ether and in 11 parts of chloroform; also soluble in oil of turpentine and in fixed or volatile oils.

Impurities.	Tests for Impurities.
Fats, or Fatty Acids, Japan Wax, Resin.	If 1 Gm. of Wax be boiled for half an hour with 40 Gm. of solution of soda (sp. gr. 1.180), the volume being preserved by the occasional addition of water, the Wax should separate, on cooling, without rendering the liquid opaque, and no precipitate should be produced in the filtered liquid by hydrochloric acid.
Soap.	The above reagent should not produce a precipitate in water which has been boiled with a portion of the Wax.
Paraffin.	If 5 Gm. of Wax be heated in a flask for fifteen minutes with 25 Gm. of sulphuric acid to 160° C. (320° F.), and the mixture diluted with water, no solid, wax-like body should separate.

White Wax.—The color of yellow wax is discharged by exposing it, with an extended surface, to the combined influence of air, light, and moisture. The process of bleaching is often conducted upon a large scale. The wax, previously melted, is made to fall in streams upon a revolving cylinder, kept constantly wet, upon which it concretes, forming thin layers. These, having been removed, are spread upon linen cloths stretched on frames, and exposed to the air and light, care being taken to wet and occasionally turn them. In a few days they are partially bleached; but, to deprive the wax completely of color, it is necessary to repeat the whole process once, if not oftener. When sufficiently white, it is melted and cast into small circular cakes.

It is a yellowish-white solid, generally in the form of circular cakes, about four inches (10 cm.) in diameter, somewhat translucent in thin

layers, having a slightly rancid odor and an insipid taste. It melts at about 65° C. (149° F.). Sp. gr. 0.965–0.975. In other respects it has the characteristics and answers to the tests mentioned under Yellow Wax (see above).

Uses.—Wax is used in pharmacy principally to give consistence to cerates and ointments.

Unofficinal Animal Products.

Class, Mammalia.

Ambra Grisea. **Ambergris.** A morbid excretion from the intestines of *Physeter macrocephalus*, found floating on the sea. It is friable when cold, of a gray or brown-gray color. It contains 85 per cent. of ambrein, etc. Used in perfumery.

Sanguis. **Blood.** The arterial fluid of the ox, *Bos Taurus*. It is of a red color, opaque, and has a peculiar odor. It contains 78 per cent. of water, 8 per cent. of albumen, 5 per cent. of fibrin, etc. The red color is due to *hæmoglobin*.

Butyrum. **Butter.** From the milk of the cow, *Bos Taurus*. Obtained by allowing the cream to separate from the milk, collecting and churning. A soft, yellow, neutral substance, of a pleasant, sweet odor and a bland taste. It contains 30 per cent. of olein, and about 68 per cent. of palmitin and stearin, etc.

Castoreum. **Castor.** From the preputial follicles of both the male and female animals *Castor Fiber*. The follicles occur in pairs, are pyriform, of a brown or blackish color, a peculiar odor, and a bitter, acrid, and nauseous taste. It contains a volatile oil, and from 15 to 40 per cent. of a bitterish resinous substance, etc.

Civetta. **Civet.** An odorous substance obtained from two animals of the genus *Viverra* which inhabit the East Indies. It is semi-solid, unctuous, yellowish, becoming brown and thicker by exposure to air; of a very strong, peculiar odor, and a bitterish, acrid, and nauseous taste. It contains volatile oil, and resinous and other matters. Used in perfumery.

Extractum Carnis. **Extract of Beef.** Prepared by subjecting beef contained in iron cylinders heated by steam to a temperature of 220° F. for several hours, collecting, when cool, the solidified juice, and preserving it in well-closed cans.

Fibrin. Obtained when blood is allowed to coagulate or is whipped with a bundle of twigs. It is at first, when pure, a gelatinous mass, which changes to a white, tenacious material, consisting of minute fibrils.

Gelatina. **Gelatin.** Obtained by boiling in water, bone, skins, cartilage, tendons, etc., until dissolved, then drying the resulting jelly in the air. It occurs in thin, transparent sheets. The different varieties which occur in commerce are Russian, French, Cooper's, and Coxe's gelatin.

Hyraceum. **Hyraceum.** The product of *Hyrax capensis*, an animal of Southern Africa. It is found on the rugged sides of mountains, and is supposed to be the excrement or the dried urine of the animal. It is rather hard, tenacious, of a blackish-brown color, and a taste and smell similar to those of castor.

Ingluvin. From the gizzards of *Gallus Bankiva*. Prepared by a process similar to that employed in preparing pepsin. The dried and powdered gizzards are often used as digestives.

Keratin. The organic basis of horny tissues, hair, nails, feathers, epithelium, etc.

Koumiss. Prepared by dissolving 4 ounces of white sugar in 1 gallon of skimmed milk, and placing in bottles of the capacity of 1 quart; add 2 ounces of baker's yeast, or a cake of compressed yeast, to each bottle, cork and tie securely, then set in a warm place until fermentation is well under way, and lay the bottles on their sides in a cool cellar. In three days fermentation will have progressed sufficiently to permit the koumiss to be in good condition.

Lac. **Milk.** From the mammary glands of the cow, *Bos Taurus*. It is a white, opaque liquid, having a slight odor and a bland and sweet taste. Sp. gr. 1.030. It contains 85 per cent. of water and about 15 per cent. of solids.

Milk-Casein. The most abundant of the albuminoids obtained from milk by the addition of rennet.

Mucin. A substance existing in different varieties of mucus, in the saliva, bile, connective tissues, etc. It is not coagulated by heat.

Neat's-foot Oil. Prepared by boiling the feet of cattle, deprived of their hoofs, with water, removing the oil which rises to the surface, and allowing it to remain for some time in warm water. Used for softening leather.

Unofficinal Animal Products.—(*Continued.*)

Pancreatinum. Pancreatin.	Prepared by macerating fresh and finely-chopped beef pancreas in water, acidulated with a little hydrochloric acid, for a day, and repeating the maceration with water; straining the liquids and filtering; neutralizing with calcium carbonate, and again filtering; then mixing with an equal volume of 95 per cent. alcohol, washing the precipitate with dilute alcohol, pressing between bibulous paper, and drying at the ordinary temperature. It is a transparent, brittle, yellow mass. Pancreatin is a ferment. Used for digesting oils and fats.
Paraglobulin.	Obtained from blood serum, lymph, chyle, etc. It is a granular substance, gradually becoming more compact.
Peptones.	The product of the action of gastric and pancreatic juices, or of pepsin alone, upon albuminoids during the process of digestion.
Ptyalin.	A fermentative substance occurring in saliva, and having the power of converting starch into dextrin.
Sodii Choleas. Choleate of Soda.	Prepared by evaporating fresh ox gall to one-half, and precipitating the slimy and coloring matters with an equal bulk of alcohol, treating the filtrate with animal charcoal, distilling off the alcohol, and washing the residue with ether. It occurs as a white, sticky mass, having a penetrating odor, and a peculiar, sweetish, afterwards bitter taste. (See Fel Bovis Purificatum.)
Class, Pisces.	
Dugong Oil.	From *Halicore Dugong*. Habitat, waters of Eastern Australia. This oil is generally used as a substitute for cod liver oil in Australia.
Eulachon Oil.	From *Thaleichthys Pacificus*, a small fish found on the Pacific coast. This oil has been proposed as a substitute for cod liver oil.
Menhaden Oil.	From *Alosa Menhaden*. Habitat, Atlantic coast. Used in dressing leather.
Porpoise Oil.	From *Delphinus Phocæna*. Prepared by heating the belly-blubber of the porpoise. It is, when fresh, of a pale yellow color.
Seal Oil.	From *Phoca* of various species.
Shark Oil.	From the liver of the shark, *Squalus Carcharias*, and other species. It is of a light yellow color, and has an acrid taste. Sp. gr. 0.870–0.880.
Skate Oil.	From the liver of *Raja Batis*. Employed largely in France and Belgium. It is of a bright yellow color. Sp. gr. 0.928.
Sperm Oil.	From the cranial cavities of *Physeter macrocephalus*. It is of a yellow or brown-yellow color. Sp. gr. 0.920. On cooling, it deposits spermaceti and stearin.
Whale Oil.	From *Balæna mysticetus*. It has a peculiar fishy odor and unpleasant taste.
Class, Aves.	
Albumen Ovi. Egg-Albumen.	It exists in solution, enclosed in a net-work of delicate membranes, in the white of eggs.
Vitellin.	It exists in the yolk of eggs. Closely resembles fibrin.
Class, Insecta.	
Acidum Formicum. Formic Acid.	Obtained by distilling the ant (*Formica rufa*). It is a colorless liquid, having a pungent odor, and produces a burning sensation when applied to the skin. Its vapor is inflammable. Used for neuralgic and rheumatic pains.
Cobweb.	The web of *Tegeneria domestica*. It has been recommended in phthisis and chronic intermittents, but is most useful in controlling hemorrhage by simply applying it to the bleeding surfaces.
Blatta. Cockroach.	The insect *Blatta orientalis*, about one inch long, oblong, flat, of a reddish-black color, odor very disagreeable. It contains fetid oil, extractive, antihydropin, etc. Used as a diuretic.
Red Ant.	The insect *Formica rufa*. It contains a volatile oil and formic acid.
Class, Reptilia.	
Crotalus.	Prepared from the venom of the rattlesnake (*Crotalus horridus*). While the snake is under chloroform the poison contained in the fang is pressed out and mixed with 9 parts of glycerin. Used in diphtheritic scarlatina.
Phynin.	From the glandular secretion and dried skin of the toad (*Bufo viridis* and *B. cinereus*). Similar in its effects to digitalin.
Class, Annelida.	
Hirudo. Leech.	From *Sanguisuga medicinalis* and *S. officinalis*. From three to six inches long, smooth, soft, round, tapering at the ends, composed of about one hundred rings; of a blackish-green color. Used for local depletion.

Officinal Animal Substances.

Officinal Name.	Class and Order.	Part used.	English Name.	Officinal Preparations.
Acidum Lacticum.			Lactic Acid.	Syrup of Lactophosphate of Calcium.
Acidum Oleicum.			Oleic Acid.	Oleate of Mercury, Oleate of Veratrine.
Adeps.	Class, Mammalia. Order, Pachydermata.	Prepared internal fat.	Lard.	Benzoinated Lard, Cerate, Resin Cerate, Ointment, Cantharides Cerate, Cerate of Extract of Cantharides, Mercurial Ointment, Mezereum Ointment.
Cantharis.	Class, Insecta. Order, Coleoptera.		Cantharides.	Cantharides Cerate, Cerate of Extract of Cantharides, Collodion with Cantharides, Cantharides Liniment, Tincture of Cantharides.
Carbo Animalis.			Animal Charcoal.	Purified Animal Charcoal.
Cera Alba.	Class, Insecta. Order, Hymenoptera.	Prepared concrete substance.	White Wax.	Cerate, Spermaceti Cerate, Cantharides Paper, Ointment of Rose Water.
Cera Flava.	Class, Insecta. Order, Hymenoptera.	Prepared concrete substance.	Yellow Wax.	Resin Cerate, Ointment, Cantharides Cerate, Cerate of Extract of Cantharides, Asafetida Plaster, Burgundy Pitch Plaster, Canada Pitch Plaster, Resin Plaster, Mezereum Ointment.
Cetaceum.	Class, Mammalia. Order, Cetacea.	Concrete fatty substance.	Spermaceti.	Spermaceti Cerate, Ointment of Rose Water, Cantharides Paper.
Coccus.	Class, Insecta. Order, Hemiptera.	Dried female.	Cochineal.	Compound Tincture of Cardamom.
Fel Bovis.	Class, Mammalia. Order, Ruminantia.	Fresh gall.	Ox Gall.	Inspissated Ox Gall, Purified Ox Gall.
Glycerinum.			Glycerin.	
Ichthyocolla.	Class, Pisces. Order, Sturiones.	Swimming-bladder.	Isinglass.	Isinglass Plaster.
Mel.	Class, Insecta. Order, Hymenoptera.	Saccharine secretion.	Honey.	Clarified Honey.
Moschus.	Class, Mammalia.	Dried secretion.	Musk.	Tincture of Musk.
Oleum Adipis.		Fixed oil.	Lard Oil.	Ointment of Nitrate of Mercury.
Oleum Morrhuæ.	Class, Pisces.	Fixed oil.	Cod Liver Oil.	
Pepsinum Saccharatum.			Saccharated Pepsin.	Solution of Pepsin.
Saccharum Lactis.			Sugar of Milk.	Abstracts, Saccharated Iodide of Iron, Mercury with Chalk, Denarcotized Opium, Powder of Ipecac and Opium, Triturations.
Sevum.	Class, Mammalia.	Internal fat of abdomen.	Suet.	Mercurial Ointment, Tar Ointment.
Vitellus.	Class, Aves. Order, Gallinæ.	Yolk of the egg.	Yolk of Egg.	Glycerite of Yolk of Egg.

CHAPTER LXII.

PHARMACEUTICAL TESTING.

A KNOWLEDGE of the methods of using tests with the view of identifying or ascertaining the amount of impurities in articles of the materia medica, is now demanded of the pharmacist. The professional chemist can no longer claim the exclusive right to handle the test-tube and the burette, for the principles of analysis, so far as they relate to medicinal chemicals, must be understood by the practical pharmacist. It is not within the scope of this work to enter into the minute details of the application of each test, the many excellent works on analysis which have been issued within the last five years fully supplying all needs in this direction.[1]

The introduction of many new tests into the last Pharmacopœia, however, requiring the use of various reagents and test-solutions, necessitates a brief review of the methods employed in analysis, with some definitions of common terms.

Synthesis and **Pharmacy** treat of the creation or preparation of compounds by *building them up* from their constituents: thus, by heating together iodine and sulphur, the compound, sulphur iodide, is made.

Analysis is the opposite operation: it treats of the decomposition of the compound by *separating* its constituents: if sulphur iodide be boiled with water, the iodine will be volatilized and may be collected, whilst the sulphur remains with the water, and thus the compound is decomposed and its constituents are separated.

The principles of analysis are based upon the application of one chemical substance, of known properties and composition, to another, which results in some change in the color, form, or state of aggregation of one or both substances, and which is intended to lead to the identification of the substance examined, or to the ascertainment of its quantity.

All analytical methods require the use of *reagents* and *test-solutions*. These may be defined as substances employed in producing the phenomena above described, or the *reactions* upon which the value of the analysis is based. A list of officinal reagents and test-solutions is given on pages 882–888.

Two kinds of analysis, depending upon the extent of the examination, are in use: 1. Qualitative or qualitive. 2. Quantitative or quantitive.

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[1] The practical pharmacist should be provided with one or all of the following works: Fresenius's "Analysis," Hoffman and Power's "Examination of Medicinal Chemicals," Sutton's "Volumetric Analysis," Allen's "Commercial Organic Analysis," and Trimble's "Practical and Analytical Chemistry."

In *qualitative* analysis, the aim is merely the *identity* or the *quality* of the objects sought for in the substance examined.

In *quantitative* analysis, not only must the substance sought for be identified, but the *quantity* which is present must also be ascertained. Two methods of quantitative analysis are in use, known as the Gravimetric and the Volumetric.

In *gravimetric* quantitative analysis, as its name indicates, the quantities of the constituents are isolated and *weighed*, either separately or in combination.

In *volumetric* quantitative analysis, the constituents are determined, either wholly or in part, in *volume* or *measure*, by dissolving a given weight of a pure salt or body in a definite volume of water or other liquid, thus forming a *standard* or *normal solution*, and using an accurately measured quantity of such a solution to produce a given effect upon the substance which is being tested. The advantages of the volumetric method consist in the ease and rapidity with which the operations may be effected, because liquids can be measured more rapidly than they can be weighed.

It is obvious that volumetric analysis can be used only where some distinctly visible phenomenon occurs in the liquid, which enables the operator to determine accurately a point when the reaction is completed.

In volumetric analysis, accurately made solutions of definite strength are employed. In the Pharmacopœia these are termed test-solutions and volumetric solutions. In general practice the term *normal solution* is used, but, unfortunately, it is applied to several kinds of volumetric solutions, which may be defined as follows:

1. A normal solution is primarily and legitimately one which contains the *molecular weight* of a *univalent* substance, expressed in grammes, dissolved in *one litre* of pure water: thus, the molecular weight of soda (NaHO) is 40, and hence normal solution of soda contains 40 grammes of soda in 1000 grammes, or 1 litre, of distilled water. When the substance is *bivalent*, the normal solution contains *one-half* of the molecular weight, expressed in grammes, in each litre, as in the volumetric solution of oxalic acid. The molecular weight of oxalic acid is 126, and the normal solution is made by dissolving 63 grammes of the acid in 1000 C.c. of distilled water. In trivalent substances, one-third of the molecular weight is taken, etc. *Decinormal* and *centinormal* solutions are respectively $\frac{1}{10}$ and $\frac{1}{100}$ the strength of normal solutions. Normal solutions of this kind have more than one use, for they are employed in determining the strength and purity of *many* substances.

2. The term normal solution is, unfortunately, applied also to a liquid of which a given volume (100 C.c.) corresponds with, or exactly saturates, a given weight (1 Gm.) of only *one* substance. These test-liquids are used for technical purposes, and are of use only when employed for the single object for which they were designed: they are intended to indicate the percentage of the pure substance contained in the product examined. They are often employed by manufacturing chemists.

3. Still another kind of normal solution has its strength based on a *special reaction* which takes place when the solution is used for the purpose for which it was intended, the molecular weight or saturating

power having no relation to its strength.[1] Normal solution of potassium permanganate is sometimes made in this way, based on the amount of oxygen that it can transfer to the substance under examination.

Proximate analysis is a term applied to the examination of organic substances with the view of isolating or determining the proximate principles present, as the proximate analysis of cinchona bark in proving the presence or quantity of the quinine, cinchonine, kinic acid, etc.

Ultimate analysis is a term applied to the examination of organic substances to determine their ultimate elements, as in an analysis of quinine to prove the number of atoms of carbon, hydrogen, oxygen, and nitrogen in it.

Proximate and ultimate analyses require individual skill and experience and the application of methods which can be properly mastered only by special study and practical experience under competent instructors. They should never be attempted by the tyro.

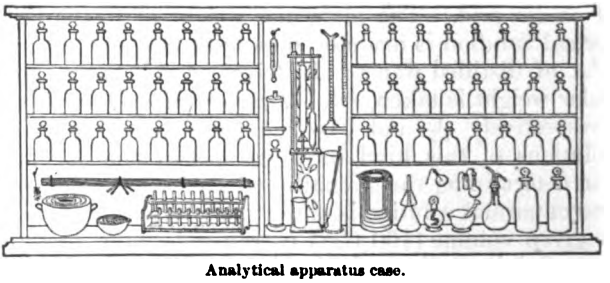
Pharmacopœial testing and volumetric analysis, on the other hand, are directly in the line of the work of the practical pharmacist, and the apparatus required is simple, whilst the operations to be performed are mostly those which he is called upon to perform daily upon a larger scale.

Practice and experience in analytical work will, if conscientiously followed, prove invaluable in training the pharmacist in those habits of accuracy, neatness, and thoroughness which are absolutely essential to the successful pursuit of his profession.

Apparatus used in Testing.

The United States Pharmacopœia very wisely adopted the metric system in all analytical operations requiring definite weights or measures. It is admirably fitted for analytical work, and is used almost universally by chemists throughout the world: hence the apparatus employed is always based on the metric method.

FIG. 336.



Analytical apparatus case.

It is well for the pharmacist to set apart a case, especially in the laboratory, in which to keep this apparatus. It should never be used for dispensing purposes. Fig. 336 represents such a case, which may be made as attractive as the taste of the owner dictates.

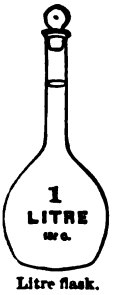
[1] It is greatly to be desired that these last two solutions shall receive some other and appropriate names, and that hereafter the term "normal solution" shall have but one signification.

Graduated Flasks are needed for making standard and normal solutions. These should be accurately stoppered, and the mark on the neck should extend all the way around, and be in the narrowest part. Litre, half-litre, and quarter-litre flasks are all useful (see Fig. 337).

Graduated Jars.—A tall, cylindrical, glass-stoppered jar, graduated into one hundred or one thousand equal parts, is of great service in making test-solutions in smaller quantities (see Fig. 338).

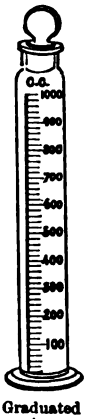
The Burette is indispensable in volumetric testing. It is a graduated glass tube, about one-half inch (12.5 mm.) in diameter and twenty inches (50.8 cm.) in length, having its lower end drawn to a narrow orifice, and the other slightly flared to facilitate the pouring in of the test-liquid: to the lower extremity is attached a piece of rubber tubing, the other end of the tubing being armed with a short piece of glass tube having a capillary orifice. The graduations on the tube are extended to one hundred parts or more, each part being subdivided into five or ten equal parts (see Fig. 339). The rubber tube is closed with a spring pinchcock, the form shown in Fig. 161 being preferred. Fig. 340 represents a convenient holder for the burette whilst in use: the latter may be adjusted to any height to accommodate a large or a small beaker. For test-solutions that are decomposed by organic substances, like solution of potassium permanganate, the rubber tube is

FIG. 337.



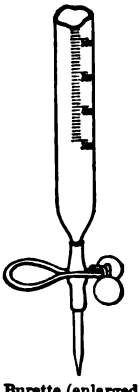
Litre flask.

FIG. 338.



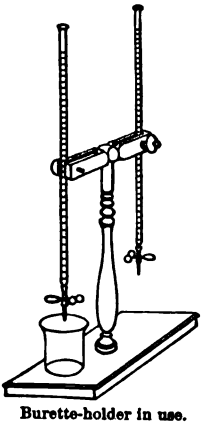
Graduated jar.

FIG. 339.



Burette (enlarged view of end).

FIG. 340.



Burette-holder in use.

unsuitable, and *all glass* burettes must be used: these are closed with a small glass stopcock. To facilitate the reading of the divisions on the burette, Erdmann's float is employed (see Fig. 341): this is an elongated glass bulb, of slightly less diameter than the burette, loaded at one end with mercury, and having a little glass hook at the top to facilitate its being lifted out with a bent wire: a line is scratched on the bulb around the middle, and it is floated in the liquid in the burette. The actual height of the liquid is a matter of indifference, because the reading is made by comparing the line on the float with that on the burette. With practice, excellent work may be performed without the use of the float, by adopting the habit of always reading off where the lowest point of the

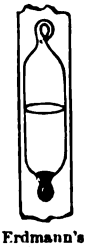
meniscus touches the graduated mark. If the operator is compelled to work in a poor light, the reading of the line may be facilitated by placing a small card, having its lower half blackened, just behind the burette in such a position that the straight line of division between the black and the white portion is very slightly below the surface of the liquid in the burette.

Pipettes may be used for qualitative testing or in small operations. These are intended to be filled by sucking into the graduated tube the quantity of liquid desired: it is retained there by pressing the moistened forefinger on the upper orifice; of course upon raising the finger and applying it again the desired quantity may be made to flow out (see Fig. 342).

The greater part of the apparatus used in such analytical work as the pharmacist is likely to be called upon to perform has been already described in Part I. and elsewhere, and the operations of making solutions, filtration, precipitation, etc., are familiar ones. Glass funnels, beakers, test-tubes, stirring-rods, porcelain capsules, crucibles, reagent and test-solution bottles, etc., will be required.

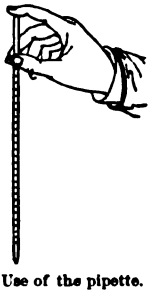
The amber-glass reagent bottles made by Whitall, Tatum & Co., of Philadelphia (see Fig. 343), are well adapted for the purpose of containing the test-liquids. The bottles hold about four fluidounces, and the

FIG. 341.



Erdmann's float.

FIG. 342.



Use of the pipette.

FIG. 343.

Reagent bottle.

labels are blown in the glass, the surface of the letters being ground off so that they can be read distinctly. Paper labels are not well adapted for test-liquids, because they are soon destroyed by the corrosive action of acid vapors or the ink-marks are bleached out.

ARTICLES USED IN TESTING. *U.S.* 1880.

Absolute Alcohol.—Ethyl Alcohol [C_2H_6HO; 46] nearly or quite free from water. It should have the specific gravity 0.794 at 15.6° C. (60° F.); should respond to the tests of purity given under Alcohol; and a portion shaken with well-dried sulphate of copper should not impart color to the latter.

Acids.—All acids used in testing must fulfil the requirements of strength and purity mentioned in the Pharmacopœia, with the additional condition, that the reactions for purity shall not depend upon a limit of time, nor permit any recognizable trace of impurity. Besides responding to all other tests for purity, *Hydrochloric Acid*, diluted with five times its volume of distilled water, and *Sulphuric Acid*, diluted with fifteen times its volume of distilled water, when treated by the method given under Test-Zinc, should give no indication of the presence of arsenic.

Aluminium.—Metallic Aluminium [Al; 27] in the form of wire or ribbon. It should be soluble in solution of potassa, without leaving a residue.

Chromate of Potassium.—The crystallized salt [K_2CrO_4; 194.4.].

Copper.—Metallic Copper [Cu; 63.2] in slender wire, or thin foil cut into strips.

Gelatinized Starch.—A gelatinous solution, freshly prepared by mixing *one part* of Starch (see Amylum) with *two hundred parts* of distilled water, and boiling the mixture for five or six minutes.

Gold.—Metallic Gold [Au; 196.2] in the form of leaf. It should not be affected by nitric acid, but should readily dissolve, without residue, in nitrohydrochloric acid.

Hydrosulphuric Acid.—The gas [H_2S; 34] generated by treating Ferrous Sulphide [FeS; 87.9] with Diluted Sulphuric Acid (see page 414), and washed by being passed through a small quantity of distilled water in a wash-bottle. *One part* of ferrous sulphide is sufficient for *fifteen parts* of diluted sulphuric acid, or for *one and a half parts* of sulphuric acid when this is diluted with *eight* to *ten times* its weight of distilled water; and the resulting gas will saturate about *fifty parts* of distilled water. Distilled water so saturated may be used, when fresh, as a test-solution of Hydrosulphuric Acid. It should give the strong odor of the acid, and should abundantly blacken test-solution of acetate of lead.

Indigo.—Indigo Blue [C_8H_5NO; 131].

Litmus Paper.—*Blue Litmus Paper.* Unsized white paper colored with Solution of Litmus. *Red Litmus Paper.* Unsized white paper colored with Solution of Litmus previously reddened by the smallest requisite quantity of sulphuric acid.

Molybdate of Sodium.—The salt [$Na_2MoO_4.H_2O$; 223.5] in crystals, or in clear, white, fused masses.

Solution of Litmus.—A solution prepared by macerating *one part* of Litmus, in powder, with *ten parts* of Diluted Alcohol, in a closed vessel, for two days, and filtering.

Solution of Turmeric.—A solution prepared by macerating *one part* of bruised Turmeric, with *six parts* of Diluted Alcohol, in a closed vessel, for seven days, and filtering.

Turmeric Paper.—Unsized white paper colored with Solution of Turmeric, by steeping and drying it without the application of heat.

Test-Zinc.—Metallic Zinc [Zn; 64.9] free from arsenic, and in slender sticks, or small fragments, or in thin disks, prepared by melting the metal and pouring it in a thin stream into water.

Test-Zinc should be soluble in diluted sulphuric acid and leave no residue or not more than a slight one (absence of more than small proportions of lead). If Test-Zinc does not cause rapid effervescence in diluted sulphuric acid, this difficulty may be overcome by sprinkling the metal with test-solution of platinic chloride previously diluted with about five hundred times its volume of distilled water, and then drying on the water-bath.

Test for the Absence of Arsenic.—A flask of 300 to 400 C.c. capacity is connected, through a tubulated stopper, with a drying-tube, one end of which is filled with fragments of dried chloride of calcium, and the other end with fragments of dry potassa or soda. The drying-tube is connected with a horizontal tube of hard glass, about ten inches (25 cm.) in length and one-fourth of an inch (6 mm.) in diameter, having the farther end drawn out narrow and turned downward, so as nearly to reach the bottom of a test-tube adjusted to receive it. Near its further horizontal portion, the hard glass tube is narrowed to about one-third its diameter, and the whole tube is supported securely, leaving a space of three inches (7 cm.), next before the narrowed portion, free from the flame of a lamp placed underneath. A portion of 4 to 5 Gm. of the Zinc to be tested is placed in the flask, with 120 to 150 C.c. of diluted sulphuric acid (known to be free from arsenic), the connections are closed, and 3 or 4 C.c. of test-solution of nitrate of silver poured in the test-tube to receive the gas. When the gas has bubbled briskly through the solution in the test-tube for at least five minutes, and until the air is expelled from the apparatus, the lamp is placed so as to heat the hard glass tube nearly or quite to redness, and this temperature is maintained for at least twenty minutes, while the gas is passing. No mirror should appear in the narrowed portion of the heated tube, beyond the flame, and no black precipitate, or not more than a slight darkening of color, should appear in the test-solution of nitrate of silver (absence of arsenic). Also no mirror should appear in the tube next before its heated portion (absence of antimony).

Water.—Whenever Water is mentioned in the descriptions of chemicals, or for use in any test, Distilled Water is to be employed.

TEST-SOLUTIONS. *U.S.*

[Test-Solutions should be preserved in well-stopped bottles of hard glass.]

Test-Solution of Acetate of Lead.—A solution of *one part* of Acetate of Lead in *ten parts* of distilled water, with the addition of a few drops of Acetic Acid if necessary to give the liquid a faint acid reaction. The solution should be clear.

Test-Solution of Albumen.—A solution recently prepared by triturating the White of one Egg with 100 C.c. of distilled water and filtering through cotton moistened with distilled water.

Test-Solution of Ammonio-Nitrate of Silver.—A solution prepared by adding Water of Ammonia, in drops, to Test-Solution of Nitrate of Silver, until the precipitate at first formed is very nearly all dissolved, and filtering.

Test-Solution of Ammonio-Sulphate of Copper.—A solution prepared by adding Water of Ammonia, in drops, to Test-Solution of Sulphate of Copper, until the precipitate at first formed is very nearly all dissolved, and filtering.

Test-Solution of Bichromate of Potassium.—A clear solution prepared by dissolving *one part* of Bichromate of Potassium in *ten parts* of distilled water.

Test-Solution of Bitartrate of Sodium.—A clear solution prepared by dissolving *one part* of pure Bitartrate of Sodium [$NaHC_4H_4O_6.H_2O$] in *ten parts* of distilled water, with the aid of heat, and filtering when cold.

Test-Solution of Carbonate of Ammonium.—A clear solution prepared by dissolving *one part* of Carbonate of Ammonium in *ten parts* of distilled water.

Test-Solution of Carbonate of Sodium.—A clear solution prepared by dissolving *one part* of Carbonate of Sodium in *ten parts* of distilled water.

Test-Solution of Chloride of Ammonium.—A clear solution prepared by dissolving *one part* of Chloride of Ammonium in *ten parts* of distilled water.

Test-Solution of Chloride of Barium.—A clear solution prepared by dissolving *one part* of pure crystallized Chloride of Barium [$BaCl_2.2H_2O$; 243.6] in *ten parts* of distilled water.

Test-Solution of Chloride of Calcium.—A clear solution prepared by dissolving *one part* of pure crystallized Chloride of Calcium [$CaCl_2.6H_2O$; 218.8] in *ten parts* of distilled water.

Test-Solution of Chloride of Gold.—A clear solution prepared by dissolving *one part* of Chloride of Gold [$AuCl_3$; 302.4] in *twenty parts* of distilled water.

Test-Solution of Chromate of Potassium.—A clear solution prepared by dissolving *one part* of pure Chromate of Potassium [K_2CrO_4; 194.4] in *ten parts* of distilled water.

Test-Solution of Ferric Chloride.—A clear solution prepared by dissolving *one part* of Ferric Chloride in *ten parts* of distilled water.

Test Solution of Ferricyanide of Potassium.—A recently prepared and perfectly clear solution made by dissolving *one part* of pure Ferricyanide of Potassium [$K_3Fe(CN)_6$; 328.9] in *ten parts* of distilled water. A portion of the solution diluted with ten times its volume of distilled water should give no blue precipitate on the addition of a few drops of test-solution of ferric chloride.

Test-Solution of Ferrocyanide of Potassium.—A clear solution prepared by dissolving *one part* of Ferrocyanide of Potassium in *ten parts* of distilled water.

Test-Solution of Ferrous Sulphate.—A recently prepared solution made by dissolving *one part* of selected, clear crystals of Ferrous Sulphate in *ten parts* of distilled water. A portion of the solution, diluted with ten times its volume of distilled water, should give an abundant, blue precipitate on the addition of a few drops of test-solution of ferricyanide of potassium.

Test-Solution of Gelatin.—A solution recently prepared by digesting *one part* of Isinglass in *fifty parts* of distilled water, on a water-bath, for half an hour, and, if necessary, filtering through cotton moistened with distilled water.

Test-Solution of Hydrosulphuric Acid.—A solution of Hydrosulphuric Acid gas in distilled water, as described under Hydrosulphuric Acid (see page 883).

Test-Solution of Hyposulphite of Sodium.—A clear solution prepared by dissolving *one part* of Hyposulphite of Sodium in *ten parts* of distilled water.

Test-Solution of Indigo.—A liquid prepared by digesting *one part* of Indigo, in powder, with *twelve parts* of Sulphuric Acid, on a water-bath, for one hour, pouring the solution into *five hundred parts* of Sulphuric Acid, then leaving the mixture to subside, and decanting the clear portion for use.

Test-Solution of Iodide of Mercury and Potassium.—A clear solution prepared by adding *one hundred parts* of test-solution of mercuric chloride to *three hundred and sixty-seven parts* of test-solution of iodide of potassium.

Test-Solution of Iodide of Potassium.—A clear, colorless solution prepared by dissolving *one part* of Iodide of Potassium in *twenty parts* of distilled water. The solution should have a neutral reaction.

Test-Solution of Iodine.—A dark-colored, clear solution prepared by dissolving *one part* of Iodine in a solution of *three parts* of Iodide of Potassium in *fifty parts* of distilled water.

Test-Solution of Magnesium.—A clear solution prepared by dissolving *one part* of Sulphate of Magnesium, and *two parts* of Chloride of Ammonium, in *eight parts* of distilled water, then adding *four parts* of Water of Ammonia, setting aside for two or three days, and filtering.

Test-Solution of Mercuric Chloride.—A clear solution prepared by dissolving *one part* of Mercuric Chloride in *twenty parts* of distilled water.

Test-Solution of Nitrate of Barium.—A clear solution prepared by dissolving *one part* of pure Nitrate of Barium [$Ba(NO_3)_2$; 260.8] in *twenty parts* of distilled water.

Test-Solution of Nitrate of Silver.—A clear solution prepared by dissolving *one part* of crystallized Nitrate of Silver in *twenty parts* of distilled water.

Test-Solution of Oxalate of Ammonium.—A clear solution prepared by dissolving *one part* of pure Oxalate of Ammonium [$(NH_4)_2C_2O_4.H_2O$; 142] in *twenty parts* of distilled water.

Test-Solution of Permanganate of Potassium.—A solution recently prepared by dissolving *one part* of Permanganate of Potassium in *one thousand parts* of distilled water. 62.8 C.c. of this solution, acidified with 5 C.c. of diluted sulphuric acid, should require 2 C.c. of the volumetric solution of oxalic acid for complete decoloration.

Test-Solution of Phosphate of Ammonium.—A clear solution prepared by dissolving *one part* of Phosphate of Ammonium in *ten parts* of distilled water.

Test-Solution of Phosphate of Sodium.—A clear solution prepared by dissolving *one part* of Phosphate of Sodium in *ten parts* of distilled water.

Test-Solution of Picric Acid.—A saturated, aqueous solution prepared by dissolving *one part* of well-crystallized Picric Acid [$HC_6H_2(NO_2)_3O$; 229] in *one hundred parts* of distilled water, by the aid of heat, setting aside to cool, and filtering after twelve hours.

Test-Solution of Platinic Chloride.—A clear solution prepared by dissolving *one part* of pure Platinic Chloride [$PtCl_45H_2O$; 426] in *twenty parts* of distilled water.

Test-Solution of Potassio-Cupric Tartrate.—A solution prepared by dissolving 6.93 Gm. of selected crystals of Sulphate of Copper in 20 C.c. of distilled water; also dissolving 36 Gm. of Tartrate of Potassium in 140 C.c. of Solution of Soda; then adding the former solution gradually to the latter, while stirring, and finally adding to the mixture a sufficient quantity of the Solution of Soda to make the liquid measure 200 C.c. Test-Solution of Potassio-Cupric Tartrate should be free from yellowish-brown sediment, and should deposit none upon boiling.

Test-Solution of Sulphate of Calcium.—A saturated solution prepared by digesting *one part* of powdered, native, crystallized Sulphate of Calcium [$CaSO_4.2H_2O$; 172] with about *three hundred parts* of distilled water, at the ordinary temperature, with repeated agitation, for several days, and decanting the clear liquid.

Test-Solution of Sulphate of Copper.—A solution prepared by dissolving *one part* of selected crystals of Sulphate of Copper in *ten parts* of distilled water.

Test-Solution of Sulphate of Potassium.—A solution prepared by dissolving *one part* of Sulphate of Potassium in *fifteen parts* of distilled water.

Test-Solution of Sulphate of Silver.—A solution prepared by dissolving *one part* of Sulphate of Silver [Ag_2SO_4; 311.4] in *two hundred and fifty parts* of distilled water, with the aid of a gentle heat.

Test-Solution of Sulphide of Ammonium.—An aqueous solution, chiefly of ammonium sulphide [$(NH_4)_2S$; 68] prepared by passing washed Hydrosulphuric Acid gas into *three parts* of Water of Ammonia until the latter is saturated with the gas, and then adding *two parts* of Water of Ammonia. The solution should not be rendered turbid by the addition of test-solution of sulphate of magnesium, or of test-solution of chloride of calcium (absence of ammonium hydrate, or carbonate).

Test-Solution of Tannic Acid.—A clear solution prepared by dissolving *one part* of Tannic Acid in *nine parts* of distilled water, and adding *one part* of alcohol. When this solution becomes turbid it should be rejected.

Test-Solution of Tartaric Acid.—A recently prepared and clear solution made by dissolving *one part* of Tartaric Acid in *five parts* of distilled water.

VOLUMETRIC SOLUTIONS FOR QUANTITATIVE TESTS. *U.S.*

Volumetric Solution of Bichromate of Potassium.

$K_2Cr_2O_7$; 294.8. 14.74 Gm. in 1000 C.c.

Bichromate of Potassium, *fourteen and seventy-four hundredths grammes;* Distilled Water, *a sufficient quantity*, To make *one thousand cubic centimetres.* Dissolve the Bichromate of Potassium in about *seven hundred cubic centimetres* of Distilled Water, and then add of the latter enough to make the solution measure *one thousand cubic centimetres.*

Note.—In the estimation of iron, in ferrous combinations, the aqueous solution of the salt is acidified with diluted sulphuric acid, and afterwards the Volumetric Solution of Bichromate of Potassium gradually added, from a burette, until a drop taken out upon a white surface no longer shows a blue color with a drop of test-solution of ferricyanide of potassium.

One cubic centimetre is the equivalent of:

	Gramme.
Potassium Bichromate	0.01474
Iron in ferrous combination	0.01677
Ferrous Carbonate	0.08477
Ferrous Sulphate, crystallized	0.08337
Ferrous Sulphate, dried	0.05097

The following-named officinals are tested with this solution: Ferri Carbonas Saccharatus, Ferri Sulphas, Ferri Sulphas Præcipitatus.

VOLUMETRIC SOLUTION OF HYPOSULPHITE OF SODIUM. *U.S.*

$Na_2S_2O_3.5H_2O$; 248. 24.8 Gm. in 1000 C.c.

Hyposulphite of Sodium, *thirty-two grammes;* Volumetric Solution of Iodine, *one hundred cubic centimetres;* Distilled Water, *a sufficient quantity*, To make *one thousand cubic centimetres.* Dissolve the Hyposulphite of Sodium in enough Distilled Water to make the solution measure *one thousand cubic centimetres.* To the Volumetric Solution of Iodine, which should measure exactly *one hundred cubic centimetres*, add a sufficient quantity of the Solution of Hyposulphite of Sodium, from a burette, nearly to decolorize the Iodine solution, then add freshly gelatinized starch, and continue the addition of the Hyposulphite until the blue color of the mixture is just destroyed, noting the number of cubic centimetres added. Then take of the Solution of Hyposulphite of Sodium ten times this number of cubic centimetres, and add thereto enough Distilled Water to make the solution measure *one thousand cubic centimetres.* This solution should decolorize exactly an equal volume of the Volumetric Solution of Iodine.

Note.—The article to be tested, containing free iodine, either in itself or after addition of test-solution of iodide of potassium, is treated with this Volumetric Solution, added from a burette, until, on stirring, the color of iodine is just discharged. A little gelatinized starch being added just before the iodine color disappears, the addition of the solution is continued for the exact discharge of the blue color of iodized starch.

One cubic centimetre is the equivalent of:

	Gramme.
Sodium Hyposulphite, crystallized, $Na_2S_2O_3.5H_2O$	0.02480
Bromine, Br	0.00798
Chlorine, Cl	0.00354
Iodine, I	0.01266

The following-named officinals are tested with this solution: Aqua Chlori, Calx Chlorata, Iodum, Liquor Iodi Compositus, Liquor Sodæ Chloratæ, Tinctura Iodi.

VOLUMETRIC SOLUTION OF IODINE. *U.S.*

I; 126.6. 12.66 Gm. in 1000 C.c.

Iodine, *twelve and sixty-six hundredths grammes;* Iodide of Potassium, *eighteen grammes;* Distilled Water, *a sufficient quantity*, To make *one thousand cubic centi-*

metres. Dissolve the Iodide of Potassium in about *seven hundred cubic centimetres* of Distilled Water; in this solution dissolve the Iodine, and add enough Distilled Water to make the solution measure *one thousand cubic centimetres.*

Note.—The article to be tested is first treated with a little gelatinized starch, and afterwards the Volumetric Solution added, from a burette, until, on stirring, the blue color ceases to be discharged.

One cubic centimetre is the equivalent of:

	Gramme.
Iodine	0.01266
Arsenious Acid (anhydride)	0.004945
Potassium Sulphite, crystallized	0.0097
Sodium Bisulphite	0.0052
Sodium Hyposulphite, crystallized	0.0248
Sodium Sulphite, crystallized	0.0126
Sulphurous Acid (anhydride)	0.0032

The following-named officinals are tested with this solution: Acidum Arseniosum, Acidum Sulphurosum, Liquor Acidi Arseniosi, Liquor Potassii Arsenitis, Potassii Sulphis, Sodii Bisulphis, Sodii Sulphis.

VOLUMETRIC SOLUTION OF NITRATE OF SILVER. *U.S.*

$AgNO_3$; 169.7. 16.97 Gm. in 1000 C.c.

Nitrate of Silver, well crystallized and dry, *sixteen and ninety-seven hundredths grammes;* Distilled Water, *a sufficient quantity,* To make *one thousand cubic centimetres.* Dissolve the Nitrate of Silver in about *seven hundred parts* of Distilled Water, and add of the latter enough to make the solution measure *one thousand cubic centimetres.*

Note.—The Volumetric Solution is added, from a burette, to the solution to be tested, previously treated with a few drops of test-solution of bichromate of potassium, until a red precipitate remains after stirring. In testing cyanides, without addition of bichromate, the Volumetric Solution is added until a precipitate just visible remains after stirring.

One cubic centimetre is the equivalent of:

	Gramme.
Silver Nitrate	0.01697
Ammonium Bromide	0.00978
Ammonium Chloride	0.00534
Ferrous Bromide	0.010775
Ferrous Iodide	0.015455
Hydrocyanic Acid, absolute, HCN as alkali cyanide	0.0027
Hydriodic Acid	0.01276
Potassium Bromide	0.01188
Potassium Chloride	0.00744
Potassium Cyanide (to dissolve the precipitate)	0.0130
Sodium Bromide	0.01028
Sodium Chloride	0.00584

The following-named officinals are tested with this solution: Acidum Hydrocyanicum Dilutum, Ammonii Bromidum, Potassii Bromidum, Potassii Cyanidum, Sodii Bromidum, Syrupus Acidi Hydriodici, Syrupus Ferri Bromidi, Syrupus Ferri Iodidi.

VOLUMETRIC SOLUTION OF OXALIC ACID. *U.S.*

$H_2C_2O_4.2H_2O$; 126. 63 Gm. in 1000 C.c.

Oxalic Acid, in perfect crystals, *sixty-three grammes;* Distilled Water, *a sufficient quantity,* To make *one thousand cubic centimetres.* Dissolve the Oxalic Acid in about *seven hundred cubic centimetres* of Distilled Water, and then add of the latter enough to make the solution measure *one thousand cubic centimetres.*

Note.—The Volumetric Solution is gradually added, from a burette, to the article to be tested, until the mixture, after stirring, shows a neutral reaction with litmus or some other suitable indicator. If carbonic acid gas be liberated in the operation, it must be wholly expelled, by heat, before the neutral reaction can be obtained.

One cubic centimetre is the equivalent of:

	Gramme.
Oxalic Acid, crystallized	0.0630
Ammonia, absolute	0.0170
Ammonium Carbonate	0.05233
Lead Acetate, crystallized	0.18925
Lead Subacetate, as $Pb_2O(C_2H_3O_2)_2$	0.13675
Potassium Acetate[1]	0.0980
Potassium Bicarbonate	0.1000
Potassium Carbonate, anhydrous	0.0690
Potassium Citrate, crystallized[1]	0.1080
Potassium Hydrate (Absolute Potassa)	0.0560
Potassium Permanganate	0.0814
Potassium Sodium Tartrate[1]	0.1410
Potassium Tartrate[1]	0.1175
Sodium Bicarbonate	0.0840
Sodium Borate, crystallized	0.1910
Sodium Carbonate, crystallized	0.1430
Sodium Carbonate, anhydrous	0.0530
Sodium Hydrate (Absolute Soda)	0.0400

The following-named officinals are tested with this solution: Ammonii Carbonas, Aqua Ammoniæ, Aqua Ammoniæ Fortior, Liquor Plumbi Subacetatis, Liquor Potassæ, Liquor Sodæ, Potassa, Potassii Acetas, Potassii Bicarbonas, Potassii Carbonas, Potassii Citras, Potassii et Sodii Tartras, Potassii Permanganas, Potassii Tartras, Soda, Sodii Bicarbonas, Sodii Bicarbonas Venalis, Sodii Carbonas, Sodii Carbonas Exsiccatus, Spiritus Ammoniæ.

VOLUMETRIC SOLUTION OF SODA. *U.S.*

NaHO; 40. 40 Gm. in 1000 C.c.

Oxalic Acid, in perfect crystals, *six and three-tenths grammes;* Solution of Soda, Distilled Water, of each, *a sufficient quantity*, To make *one hundred parts.* To the Oxalic Acid add, from a burette, enough Solution of Soda exactly to neutralize the acid, as indicated by the color of litmus, and note the number of cubic centimetres of the Solution of Soda required. Take ten times this number of cubic centimetres of the same solution of Soda, and add thereto enough Distilled Water to make the solution measure *one thousand cubic centimetres.* This solution should neutralize exactly an equal volume of Volumetric Solution of Oxalic Acid.

Note.—The Volumetric Solution is gradually added, from a burette, to the article to be tested, until the mixture, on stirring, shows a neutral reaction with litmus or some other suitable indicator.

One cubic centimetre is the equivalent of:

	Gramme.
Sodium Hydrate (Absolute soda)	0.0400
Acetic Acid, absolute	0.0600
Citric Acid, crystallized	0.0700
Hydrobromic Acid, absolute	0.0808
Hydrochloric Acid, absolute	0.0364
Hydriodic Acid, absolute	0.1276
Lactic Acid, absolute	0.0900
Nitric Acid, absolute	0.0630
Oxalic Acid, crystallized	0.0630
Sulphuric Acid, absolute	0.0490
Tartaric Acid, crystallized	0.0750

The following-named officinals are tested with this solution: Acidum Aceticum, Acidum Aceticum Dilutum, Acidum Aceticum Glaciale, Acidum Citricum, Acidum Hydrobromicum Dilutum, Acidum Hydrochloricum, Acidum Hydrochloricum Dilutum, Acidum Lacticum, Acidum Nitricum, Acidum Nitricum Dilutum, Acidum Sulphuricum, Acidum Sulphuricum Aromaticum, Acidum Sulphuricum Dilutum, Acidum Tartaricum.

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[1] After ignition.

PART V.

EXTEMPORANEOUS PHARMACY.

UNDER the head of Extemporaneous Pharmacy will be considered mainly the preparation and dispensing of such medicines as are intended *to meet the occasion* and are to be compounded at once. The subject of officinal or galenical pharmacy has been considered in the previous pages, the distinction being that in the latter the preparations are intended to be permanent, and are generally made in advance and kept on hand ready for use, whilst those which are extemporaneous are only intended to last during the occasion which calls them into existence.

There are several classes of officinal medicines in which permanent and extemporaneous preparations are both embraced: it has been deemed most practical to consider such under the above head. Examples are found in plasters, powders, ointments, etc. Some of these are generally kept on hand ready for use. If they are not called for soon, they become stale or deteriorated, and experience soon demonstrates that the best plan is rapidly to improve the apparatus and facilities of the store to the highest point, so that all extemporaneous preparations may be quickly and skilfully compounded on call, and thus a reputation is soon acquired for always dispensing those which are fresh. For this reason, most ointments should not be made in larger quantities than are necessary to supply the demand of the moment.

Extemporaneous Pharmacy is probably the most important division of the whole subject. It embraces the principal amount of the labor in the store, and calls for the exercise of more tact, knowledge, and ability than any other branch. Owing to the fact that the ability to practise extemporaneous pharmacy successfully depends largely upon the personal qualities of the pharmacist, very little can be written upon the subject which would be generally useful. Good training under the watchful eye of a skilled preceptor and practical experience will alone give the confidence and knowledge of details that assure success. All that will be attempted under this head will be to collect and arrange such points as the author has found useful in his own experience, in the hope that at least some of them may be of service to others. A chapter on the arrangement of the store, with a description of the facilities for practising extemporaneous pharmacy, will properly introduce the subject.

CHAPTER LXIII.

DISPENSING.

Arrangement of the Store, Laboratory, and Cellar.

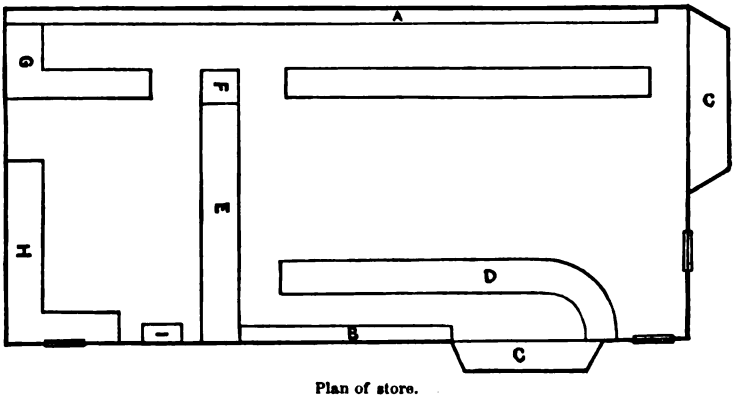
Selecting a Location for a Dispensing Store.—The selection of a proper location for establishing a pharmacy is in some respects the most important and responsible of all the duties of the pharmacist. As it is largely a question depending upon the personal qualifications, attainments, and financial ability of the individual or firm, it would be useless to offer anything more than a general observation upon this subject. Every pharmacist should select the location in which he will be most likely to achieve the greatest amount of *success*. The foregoing sentence will probably be construed by most readers to mean the field which will yield the largest pecuniary return; yet he is wisest whose expectations are tempered with moderation, and who looks for his reward to the happiness and satisfaction derived from a life filled with those daily deeds of service to his fellow-men, which from long custom or lack of appreciation fail to be classed as merchantable commodities. The general practice in America is to select a prominent place for a pharmacy at the intersection of principal streets, and the "corner drug-store" is a well-known phrase. Aside from the business view concerned in this selection, there is a great advantage derived from the presence of better light and ventilation in a corner location. At the same time, there are the disadvantages of double the amount of dust and exposure from the streets, with the necessary depreciation of the stock, as well as others of minor importance.

Apportioning Space.[1]—The room should be at least twice as long as it is broad, in order that a suitable division of the space may be secured, so that about two-thirds may be devoted to dispensing and one-third to compounding. A high ceiling is a great desideratum. The doors should be ample, with movable transoms to secure ventilation and permit the escape of the heated air and vapors which accumulate from the lights at night and from other sources. The transoms may be suspended in the middle, and during the day, even in winter, if they are kept partly opened, the condensation of moisture upon the glass bulk-windows, due to evaporating operations going on in the store or laboratory, will be largely avoided. If a chimney-breast is available in the room, it will be found a desirable acquisition in aiding in ventilation and the escape of noxious vapors arising from chemical operations.

[1] For some excellent suggestions as to the arrangement of fixtures, etc., see a paper by J. F. Hancock, Proc. Amer. Pharm. Association, 1872, p. 192.

The dispensing department is used principally for displaying the stock and for conducting the business with the customers, the prescription department for compounding prescriptions and making preparations. Much diversity of opinion exists among good pharmacists with regard to the proper method of division between these two departments. Some hold that they should be entirely separated from each other, the prescriptions being compounded in a separate room; others, that nothing but a low counter should mark the dividing-line. Probably the most satisfactory arrangement to adopt is to place across the store a prescription counter having a large glass plate in the centre, which will permit the customer to see into the prescription department if he desires to, but which will not be a standing invitation to inquisitive persons to walk in and annoy by conversation those who are engaged in compounding prescriptions.

FIG. 344.



Plan of store.

Fig. 344 shows the plan of a corner pharmacy adapted for a moderate business. It provides for two windows, C C, and two doors. A B represents the space devoted to upright fixtures and shelving,—A, the former, for the bottles, drawers, cans, drawer-cans, etc.; B, closets for holding finished packages ready for sale. In front of A the long main counter is shown, whilst D represents the second counter. The spaces E and F are apportioned for the prescription counter, and the adjoining desks, G and H, show spaces devoted to working counters for pharmaceutical operations, while I represents the sink convenient to both.

Window-Fixtures.—Plate-glass, although expensive, is now so generally in use, and so satisfactory, that it is usually true economy to select it for bulk-windows.

The principal adornments of the pharmacist's window are those ancient emblems of his art,—the show-bottles. These should never be exhibited if they cannot be made to present a creditable appearance. They need not be of elaborately cut glass, but the colored liquids should be bright and transparent and the bottles clean and free from dirt and dust. (Formulas for show-bottle colors are given in Part VI.)

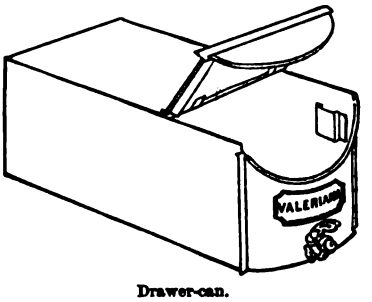
Arrangement of Objects.—One of the most difficult subjects to treat is the proper arrangement of a pharmacist's window. In the general stores of our large cities, window-dressing, as it is termed, is in the hands of trained men, who earn a comfortable livelihood by the "profession." It is far easier to note the objects which should not be exposed than to indicate those which are suitable. *Legitimate and proper objects are always found in the products of the pharmacist's own skill and labor.* Many chemical salts can be crystallized in thin glass dishes, and these, if the salt is colorless or white, can be shown to advantage on a background of black velvet; if the salt is dark-colored, like chrome alum, a white background should be chosen. Masses of crystals of various colors, alum, sulphate of copper, ferrocyanide of potassium, etc., form attractive objects, if they are novelties. These may be obtained from the manufacturing chemists. Chemical or pharmaceutical apparatus, tastefully displayed, rarely fails to excite the admiration of the passers-by, whilst if some simple pharmaceutical process is shown in automatic operation, such as the distillation of water or colored liquids in glass retorts, with a glass Liebig condenser, two objects are gained: a supply of the distillate is secured, and the reason for possessing the window is legitimately realized. Growing plants of the materia medica can often be obtained by applying to conservatories, or, with the exercise of a little patience and care, some of these may be grown at home. If these plants be rare, or of foreign origin, the interest will be greatly enhanced. This point, however, should always be kept in view: the objects should have some connection with pharmacy. Appropriate labels should accompany the objects exhibited, or the annoyance of having to answer trivial questions many times in the day will be experienced. An instructive *series* of pharmaceutical exhibitions may be devised, the series to extend through many months. To illustrate: an empty ceroon which has held cinchona bark should be obtained, and a reproduction made, through the aid of some friend clever with the pencil, of some of the prints to be found in the books, of natives gathering cinchona bark, and also of the cinchona-tree. Some large, handsome pieces of the bark should be selected, showing the different grades and qualities. Then there should be exhibited, in appropriate bottles, a series of all the *home-made* pharmaceutical preparations of cinchona bark, and, for the centre-piece, choice specimens of all the cinchona alkaloids; then the pharmaceutical preparations of the alkaloids in the background, etc. A clearly-written statement should be shown in the window, giving interesting details of each object. When the interest in this subject has waned, the same method may be applied to nux vomica, coca, rhubarb, opium, eucalyptus, senna, etc., and other similar subjects. It will be readily seen that the purpose of exhibitions of this character is to impress the community with the fact that the proprietor of the store is not only a merchant and dealer in the products of the skill of others, but is also a manufacturer himself.

Exhibitions of a more elaborate and valuable character will readily suggest themselves to the minds of many; but want of space prevents any further hints on our part. It must be clear, however, that

displays of the above character are more in keeping with the professional status of the pharmacist in the community than the heterogeneous and often vulgar exhibitions of objects usually seen in druggists' show-windows.

Shelving and Wall-Fixtures.—The character of the permanent fixtures of the store has much to do with the comfort and convenience of conducting a pharmacy. The selection of the kind of wood to be used will depend upon the amount of light in the store, the location, and the climate. *Hard wood* is always the cheapest in the end, although the most expensive at first. If the room is exposed to a great deal of light, black walnut is to be preferred, because it shows discolorations less than any other hard wood; but if the tone of the room is dark, a more cheerful appearance must be given to the store, and oak, ash, cherry, or mahogany will be preferable: oak and ash, however, are not so serviceable as the others, because of their tendency to show stains. The wall-fixtures generally consist of a long row of drawers four feet high, with shelves above for holding the shop-bottles, cans, etc., on one side, and of a series of closets below, with shelves having glass fronts above, for the other side. Most crude drugs and chemicals, herbs, etc., are kept in wooden drawers arranged in sections. The objections to wooden drawers for this purpose are several. If the drug is odorous, like valerian, sassafras, asafetida, etc., it will surely communicate its peculiarities to its less-pronounced neighbors, like arrowroot, bicarbonate of soda, etc. Again, rats and mice have strong likings for some of the articles of the materia medica, and a wooden drawer offers no impediment to their sharp teeth. Japanned and lacquered tin or tinned-copper cans appropriately labelled have come into use as substitutes, and when properly made are perfectly satisfactory. Fig. 345 shows a can which is intended to take the place of a drawer. The lid is so arranged that the drawer must be pulled out nearly half-way before it can be raised,—the advantage being that the bad habit of leaving the drawers partly open, thus permitting the admission of foreign substances, vermin, etc., is obviated, there being but two possible positions for this drawer-can: one with the lid raised and the mouth of the can wide open, the other with the lid down close. The label-case in the corner is the suggestion of Charles A. Heinitsh, of Lancaster. It has the merit of keeping the label for each drug in its appropriate container. Instead of the unbroken and monotonous array of drawers so frequently seen, a more convenient arrangement, presenting a better appearance, will be found to consist in alternating the sections of drawers or drawer-cans with closets, as shown in Fig. 346. These closets should be used for packages and articles which are generally in active demand and which must be dispensed quickly. In this connection it may be stated that a stock of small packages of regular articles of the materia

FIG. 345.

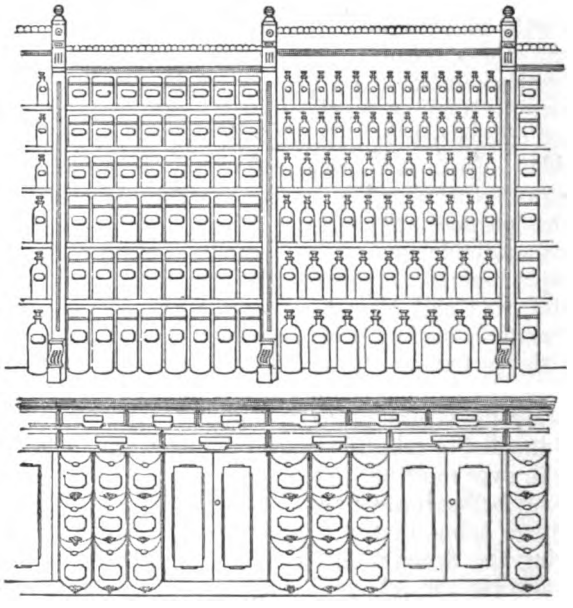


Drawer-can.

medica, like flowers of sulphur, cream of tartar, bicarbonate of sodium, in the quantities frequently demanded by customers, should be kept in a box or compartment of the drawers or drawer-cans. This plan greatly facilitates quick dispensing, economizes time and labor, and leads the assistant to make neat packages, by training him in that duty thoroughly at times when he is not otherwise engaged. If there is not room in the proper receptacle for these labelled packages, they may be kept in glass furniture-jars in some accessible place.

Fig. 346 also illustrates the arrangement of two sections of fixtures, one for bottles and the other for cans. Each section should be independent, or joined to its neighbor with dowel-pins, so that at any time they may be separated, rearranged, if necessary, or taken down entirely. The design shown is unpretentious, and intended for a store doing a moderate business. If the fixtures are made of mahogany, oak, or walnut, the effect is much better than if soft wood, painted or stained, is used. It will be observed that the proportionate height of the fixtures is such that a short ladder is necessary to reach the top row of bottles and cans. This arrangement is a matter of necessity in stores located in large cities and towns, where space is very valuable; but whenever it can be avoided it is desirable that it should be; and if the shelves are carried to just such a height as will permit the bottles to be reached without using a ladder, much inconvenience will be obviated. The careless habit of pulling out a drawer as a step to reach a bottle on an upper shelf is broken up by the use of the drawer-cans and closets, as shown in the illustration. The shallow drawers above these are not intended for holding drugs, but serve to contain small articles in constant demand, like camel's-hair pencils, gelatin pearls, seidlitz powders, etc. There should be sufficient difference between the depth of the shelves for the bottles and cans and that of the closets below to permit an eight-inch counter-top to be made above the closets. This will be almost indispensable, as affording a place for retaining packages to be sent out and of temporary lodgment for articles re-

Fig. 346.

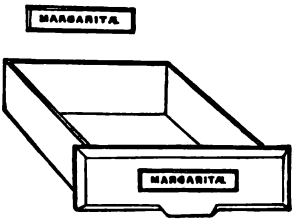


Section of wall-fixtures.

ceived. This counter should be cleared and all articles distributed every morning before the busy hours arrive.

Fig. 347 shows one of these shallow drawers. The label is the principal feature. It was devised by the author some years ago, to replace the labelled drawer-pulls furnished by the dealers in druggists' furniture, which were in use at that time and were objectionable in several respects. The simplicity and durability of this label are its prominent advantages. It is made of plate-glass, with bevelled edges; the background is of pure gold-leaf, and the letters are black and in plain Egyptian style, or black letter, without shading. They are painted upon the back of the glass, and covered with a coat of varnish. The glass label is let into the front of the door by chiselling out a depression, as deep as the glass is thick, slightly larger than the label. The back of the glass label is then covered with a thick paste of red lead in boiled linseed oil and pressed into place, the edges being finished with colored putty. The lower edge of the drawer has a projection which serves as a pull.

FIG. 347.



Shallow drawer.

Dispensing Counter.—The arrangement of the dispensing counter will depend upon whether it is to serve also as a prescription counter. A combination counter should always be avoided, if possible, as the operations involved in compounding prescriptions require the closest attention, and should always be performed where the greatest freedom from interruption can be secured. This can never be had behind the dispensing counter. The plans shown on page 891 do not, therefore, embrace a combined dispensing and prescription counter; but, if one is absolutely necessary, the main features of each can be easily merged into one. The top of the dispensing counter should be of marble or hard wood. Where space is valuable, the top of the front of the counter may overhang four inches, and room thus be obtained for a row of shelving covered with glass doors: these are shown also in front of the prescription counter (see Fig. 356). If the shelves are filled with attractive objects, particularly with special preparations made by the proprietor, they serve the excellent purpose of keeping them continually before the eye of those who frequent the store, and they may justly be called "silent salesmen." If a triangular base four inches high is placed at the bottom, no danger need be apprehended of customers breaking the glass. The case in the author's possession has been in daily use ten years without a single fracture occurring through the carelessness of a customer. The glass should be one-eighth-inch plate. If space is not particularly valuable, the counter front may be embellished with pilasters or panels, according to the taste of the owner, and the preparations shown in glass cases. A hard-wood counter will, however, prove to be much the cheaper in the end, as the front is subjected to a great deal of wear and tear and will require frequent painting if made of soft wood. The back of the counter should be utilized for containing drawers for heavy, unsightly goods, supplies

of paper, corks, twine, sponges, glue, sand-paper, plaster, labels for articles to be dispensed, etc. A sink at one end will often prove a convenience: it will, indeed, be necessary if soda-water is dispensed at this counter.

Store Furniture.—This term generally denotes the containers used to hold the medicinal substances which are to be dispensed. The furniture may consist of wide-mouth or salt-mouth bottles, wooden drawers, drawer-cans, and cans or counter-urns, for the solid articles of the materia medica, whilst the liquids are universally dispensed from bottles and cans. The furniture other than that made from glass has been already considered under the head of fixtures. The subject of the selection of the glass-ware in such sizes and shapes as shall be adapted to the wants of the store is an important one. Very little assistance, however, can be rendered in a work of this kind, because a list suitable for a store in one location would be useless for one differently situated. Practice has been materially modified of late years, particularly in arranging the *sizes* of the shop-bottles for liquids. Formerly, when tinctures were made by maceration, gallon, two-gallon, and even three-gallon bottles were to be seen upon the lowest shelf, but now it is rare to see larger than half-gallon bottles; indeed, there seems to be very little necessity for bottles larger than quart. The stock of liquid preparations being generally kept in the cellar, the shop-bottles are easily replenished from time to time as need arises. In selecting the sizes for the containers, whether of glass, tinned iron, or wood, the space to be devoted to them should first be decided upon, and then the number of bottles, cans, or drawers to occupy the space is easily determined. Having ascertained the number required of each, the selection of the proper-sized receptacle for each article should next claim attention. The following points may serve as a guide in selecting the kind of container:

1. Solid substances which are subject *to injury by exposure to light* should not be placed in glass, like salts of the alkaloids, scaled-iron salts, powdered savin, digitalis leaves, etc. 2. Odorous drugs, like hedeoma, asafetida, valerian, serpentaria, etc., should not be placed in wooden drawers, but should be put into the shop-cans. 3. Volatile oils should not be placed in the pharmacist's shop-furniture at all: small quantities only are dispensed, and the oils should be kept in small amber-glass bottles, away from exposure to light, preferably in a close closet. 4. Corrosive or deliquescent salts should not be placed in tinned-iron cans: glass vessels are properly used for these.

Glass Furniture.—Shop-bottles are generally of four kinds,—*wide-mouth* or *salt-mouth*, *tincture* or *narrow-mouth*, *syrup*, and *oil* bottles. Amber and blue glass are sometimes used,—the former for substances which are injured by light, the latter for very active poisons. Figs. 348 and 349 show cuts of the wide-mouth and other shop-bottles supplied by Whitall, Tatum & Co., of Philadelphia. A difference of opinion exists among pharmacists as to the advantage of fitting out with bottles of extra-heavy glass or with those of ordinary weight: a certain number have to be replaced every year through breakage from careless handling, but it would seem to be most economical to select the

extra-heavy bottles for liquids, notwithstanding that the percentage of loss is greater with these when the practice of suddenly pouring hot liquids into them is indulged in.

Fig. 348.

Wide-mouth furniture-bottle.

Fig. 349.

Narrow-mouth furniture-bottle.

Fig. 350.

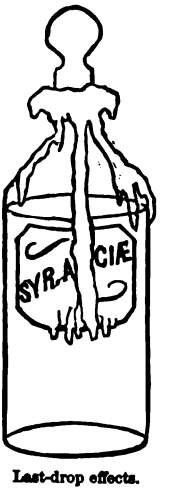
Oil-bottle.

Fig. 351.

Syrup-bottle.

The *oil-bottle* (see Fig. 350) has a cap, which protects the liquid from dust; the neck of the bottle is stopped by a tube which has a lip, whilst the base of the tube is grooved on one side, to permit the oil adhering to it to flow back into the bottle.

Fig. 352.



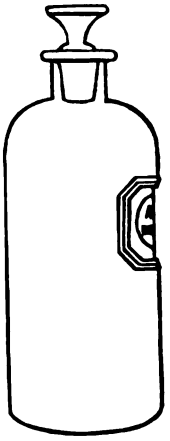
Last-drop effects.

The *syrup-bottle* (see Fig. 351) does not have a ground, close-fitting stopper as do the other bottles holding liquids, but the stopper is purposely made to enter the neck loosely; the flat lower surface of the stopper lies in contact with the upper surface of the lip of the bottle, and this forms a sufficiently tight connection to prevent loss by evaporation, exclude dust, and obviate the great inconvenience and loss of time which frequently occur when the ground-glass stopper of the syrup-bottle is found tightly cemented in the neck and a restive customer is waiting: the loose-stoppered syrup-bottle may at such times be justly regarded as a moral help, leaving no excuse for the use of smothered, but none the less intense, expressions of internal feeling. In dispensing the liquid, care should be taken to pour from the bottle with the label uppermost, so as to avoid soiling the label. The habit should be cultivated of catching the last drop from the lip on the end of the stopper, to prevent its trickling down the side of the bottle: if this is not done, a syrup-bottle may present the appearance shown in Fig. 352.

In placing the bottles upon the shelves, an alphabetical arrangement

is undoubtedly the best: it is well, however, to group the strong acids in one place, and the very poisonous liquids in another. The labelling should be distinct and easily read, and the abbreviations not so short as to allow of any misunderstanding; there should be no shading of the letters; the plain black Egyptian letter on a plain gold ground is the best on this account, whilst the combined effect in a row of bottles so labelled is richer than where some obscure or composite style of label is adopted. The glass or mica label is universally used now for bottles,—being cemented on with a cement consisting of three parts of rosin and one part of wax,—paper labels having almost gone out of use. These glass labels are subject to the disadvantage of being easily cracked and chipped, but they can be replaced so cheaply that this cannot be considered a serious objection. The recessed label has an advantage in this respect, the octagonal depression in the bottle enabling the glass label to be cemented in its place without exposing the edges, thus giving it protection. Fig. 353 shows a profile view of this label.

Fig. 353.



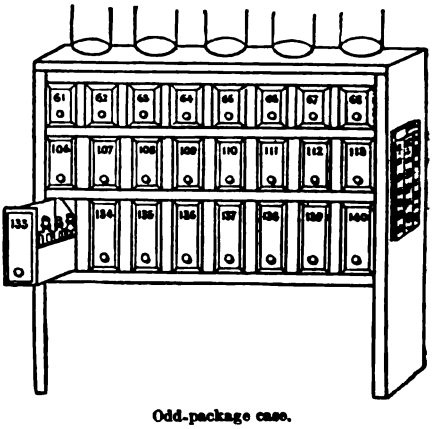
Recessed label furniture-bottle.

The following directions for attaching the glass labels are furnished by Whitall, Tatum & Co.:

Cement.—To one part of best yellow wax add three parts of rosin; melt together in an open pan or kettle, with a gentle heat, to the consistency of syrup.

Directions.—Place the bottle on a table in a nearly horizontal position in front of you; the bottle must be perfectly free from moisture. Pour the cement on the hollow side of the label with a spoon; then apply the label to the bottle with a gentle pressure. While the cement is soft, run the point of a knife around the label, so as to form a groove in the cement: this will save labor in chipping off the cement. The cement will harden in about ten minutes, when, with a putty-knife such as glaziers use, the surplus is to be removed. Clean the bottle and label with a little kerosene oil, and wipe off with a damp towel.

Fig. 354.

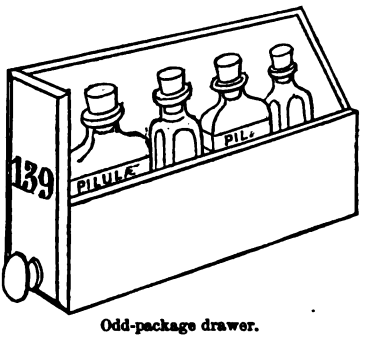


Odd-package case.

Fig. 354 shows a method of systematically storing little odd packages which are troublesome to place. This is a modification of the plan first seen by the author in Samuel A. D. Sheppard's store in Boston. A section back of the prescription counter is chosen, and a number of small drawers are arranged to hold five or six bottles in an upright

position. Fig. 355 shows an enlarged view of one of these drawers. A portion of one of the sides and of the back is cut away, to facilitate the handling of the bottles. The fronts of the drawers are of hard wood, and the drawers are numbered distinctly and consecutively. Upon the side of the section an index to the contents of the drawers is placed: this consists of a complete alphabetical list of all the odd packages in the section, and opposite each article is placed the number of the drawer in which it is contained. In practice, the bottles which are in frequent request are easily found, after once being located, without referring to the index. The advantages of this method are plain: pill-bottles, rare chemical salts, odd-sized packages which cannot be easily disposed of, are thus classified and arranged so that they can be quickly found, whilst they are protected from the effects of light, dust, and air.

FIG. 355.



Odd-package drawer.

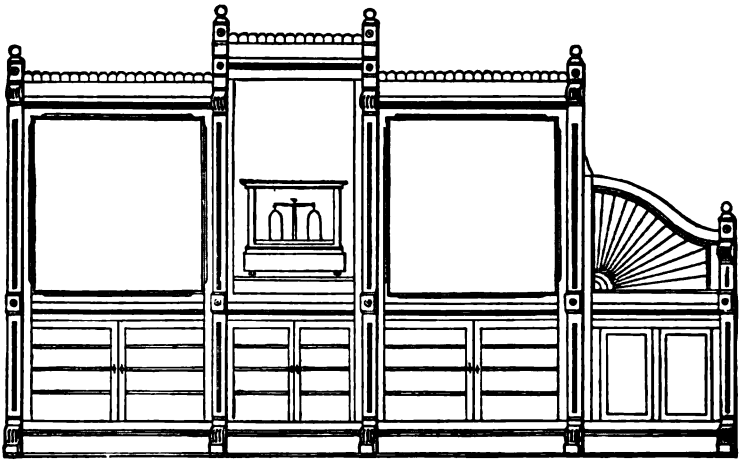
The Prescription Counter.—This will probably require more care and thought to secure the most advantageous arrangement than any other feature of the store. Good light and a convenient water-supply are absolute essentials. A corner location will generally afford a side window, from which plenty of light from the side and back may be had, whilst the sink should be close at hand. The counter should be of the same kind—hard wood—as the fixtures; or, if hard wood has not been used for the fixtures, the counter top at least should be of walnut, mahogany, oak, ash, or cherry.

Fig. 356 shows the front of a prescription counter used by the author. The upper portion is divided into three spaces, of which the middle one is covered with a single sheet of plate-glass, while the other two are occupied by plate-mirrors; the lower portion is divided into closets, which are protected by glass doors, and suitable articles are displayed on the shelves in the closets; these, like the closets under the dispensing counter, are very useful as receptacles for many small articles which are attractive to persons who are waiting for prescriptions.

The arrangement of the back of the prescription counter is probably of more importance than that of any other part of the fixtures. The fact that the customer never sees this part of the store is one of the reasons why it should *not* be neglected. The best reason for devoting thought and care to planning the arrangement of the prescription counter is that here, more than in any other place, the fate of a human life is often decided: hence system, order, and cleanliness should be the guiding rule. Fig. 357 shows the back view of the prescription counter. The upper portion presents a series of open shelves, containing rows of japanned tin cans, uniform in color and in style of label with the shop-cans. The lower shelf, in each section, is devoted to the volatile oils. These are contained in glass-stoppered bottles, which are placed in the cans; or, if preferred, the original bottles in which the oils are bought

are placed in the cans. The oils are thus protected from light, air, and dust, and in the latter case the label of the dealer is constantly before the dispenser, and the quality of the oil under surveillance. The

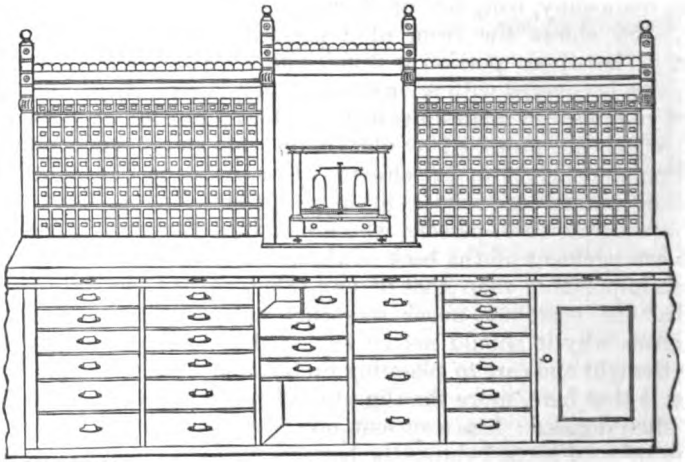
FIG. 356.



Prescription counter, front view.

second, third, and fourth rows are used to hold the chemicals and dry pharmaceutical non-poisonous products which are constantly in use. In compounding prescriptions, some of these cans are filled directly from

FIG. 357.

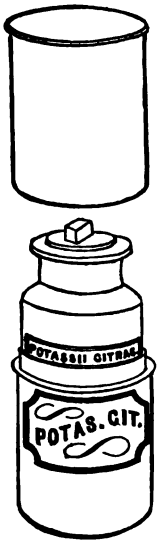


Prescription counter, back view.

the larger shop-bottles, and the substance, if without action on the tin, is not first put into smaller bottles, but is placed at once in the can. Substances like bromide of sodium, chloral, citrate of potassium, etc.,

are placed in bottles, and these then put into the proper tin cans. Fig. 358 shows one of these cans. The upper row is devoted to extracts, these being contained in jars, as shown in Fig. 359. The cans should be thoroughly japanned, and the label may be painted in large, black, distinct letters upon a gold ground. The substances should be arranged alphabetically, so that they can be readily found when wanted. This arrangement enables the dispenser to exclude the light, air, and dust from the substances, and to use the original bottles in which the manufacturer has sold the chemical, thus enabling the make to be at once identified, besides lessening the danger of errors; whilst another advantage is that the unsightly display of bottles of all sizes and shapes containing chemicals, with the labels more or less worn, soiled, and fly-specked, is avoided. The poisons, alkaloids, and very powerful substances should be kept in a separate closet, and the bottles marked with a poison-mark; for, although the pharmacist should early learn to place no absolute dependence upon any *special system* of preventing errors, but always to realize that constant, unremitting vigilance is the only safeguard, the adoption of some expedient which will aid in calling attention to poisonous compounds serves to impress upon all, particularly the junior assistants, the fact that safety can be secured only at the expense of the most scrupulous care. Fig. 360 shows Holbe's poison closet. The arrangement shows three closets in one: to each is assigned separate apparatus with lock and key. The top of the prescription counter should be made of hard wood, and at least one and a half inches thick if durability is desired. The slides shown just under the edge of the counter are very convenient. They can be relied upon, when they are pulled out, in an emergency to double the capacity of the counter. One of the slides may have a sheet of ground glass set into it by chiselling out sufficient of the wood on the face to allow the glass to be set in flush with the surface of the slide upon a bed of label-cement (three parts rosin and one part yellow wax). This forms a convenient ointment-slab, particularly for making up a rather large quantity of ointment. It is easily cleaned and kept in order. Two of the slides should be appropriated to folding powders and kept exclusively for this purpose, and one reserved for holding the pill-machine when in use, whilst one may have three circular bevelled holes of different diameters countersunk upon the front of the slide. If a strip equal in width to one-half the diameter of these depressions is sawed out, as shown in Fig. 361, and then connected by two screw-bolts which project entirely through the strip, it will be possible, by attaching thumb-screws to the

FIG. 358.



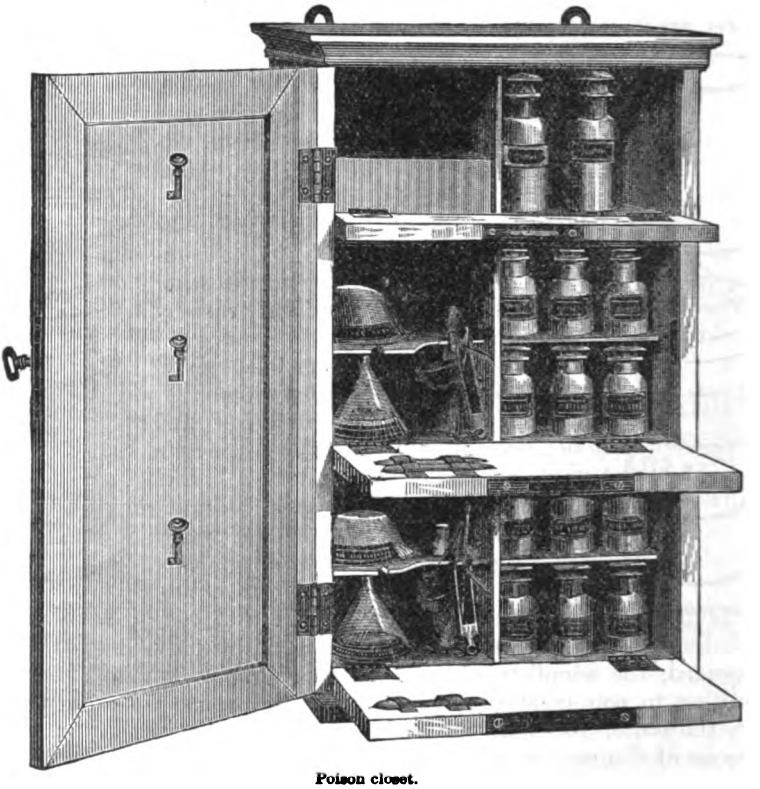
Can for prescription counter.

FIG. 359.

Extract-can for prescription counter.

ends of the bolts, to clamp the mortar securely. The depressions should be wider in diameter at the bottom than at the top, so that the "bite"

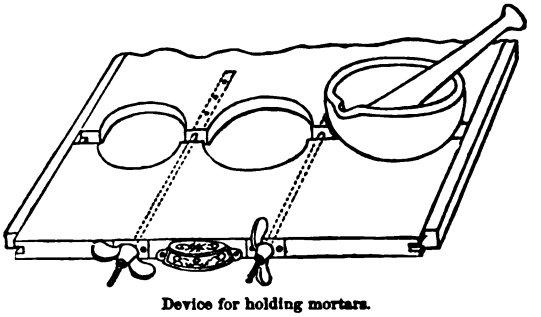
Fig. 360.



Poison closet.

of the clamp will be stronger when the mortar is securely clamped. It is useful in working tough pill masses, or in making emulsions quickly. The drawers in the counter are appropriated to various purposes. Those on the left are partitioned off, and contain pill, powder, and suppository boxes, each in its proper division. Ointment-jars of various sizes occupy another set in the next row; the top drawer and the one immediately below it contain the pill-machines; lozenge-cutters, cachet-machines, suppository-moulds, etc., are in another drawer, spatulas, stirring-rods, etc., in another. Pre-

Fig. 361.



Device for holding mortars.

scription-bottles of all sizes (cleaned and dried, and, if preferred, corked) are in the next section, whilst cut labels, capping-paper and scissors, and corks, in partitioned drawers, find places in the succeeding row. One of the upper drawers in the middle of the counter should be set apart for towels, whilst the open space below is convenient for holding the box to collect the scraps of paper and light waste which accumulate during the day. The closets hold the mortars and pestles, ointment-slabs, etc.

Arrangement of Laboratory and Cellar.—The suggestions that are to be made upon the above subject must necessarily be of a very general character, as the circumstances of pharmacists vary greatly: the apparatus employed in the making of the various preparations has been already considered under the heads devoted to the subjects, hence the general arrangement must now receive attention.

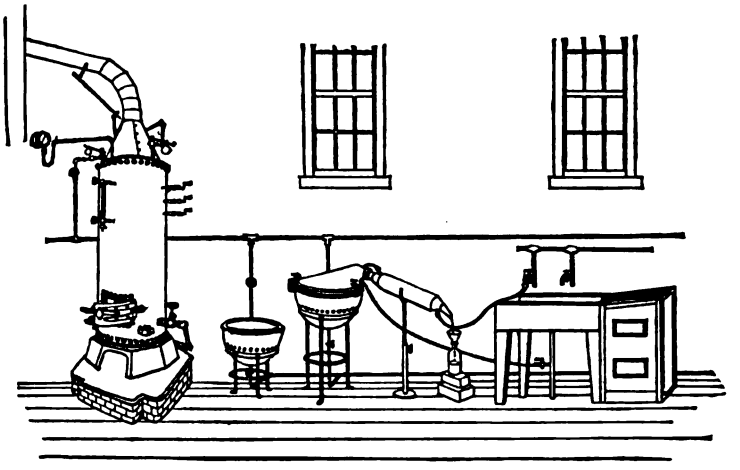
The Laboratory.—This very important room in the pharmacy should be fitted with every facility for carrying on the various operations required, with ease, rapidity, and comfort. In most establishments but one room is available for this purpose, and this directly in the rear of the dispensing-room. The manufacturing pharmacist, who makes preparations on the large scale, is compelled to devote much time and thought to the most advantageous arrangement of space, and he generally selects a location in an unfrequented portion of the town or city, or in the suburbs, where property is cheaper and railway facilities are abundant, whilst the retail pharmacist is fortunate indeed if he can set apart a special room on the first floor adjoining the dispensing-room for a laboratory. The essential features of this room are a good light, an unfailing supply of cold and hot water, a good flue for carrying off vapors, and sufficient room for counters, closets, shelving, etc.

If steam can be introduced, so that steam kettles, evaporators, etc., can be used, it will be a great convenience. The boiler may be most suitably located upon the first floor or in the cellar. In those cases where the space for a permanent boiler cannot be spared, Prof. Patch's small steam boiler may be used (see Fig. 96). This will permit the use of steam, without requiring much room, and, when an operation is concluded, the expense of keeping up the fire, as is the case in the use of coal, will be saved. A drying closet (Fig. 175) for desiccating drugs, herbs, lozenges, etc., on trays, is preferably located here, whilst furnaces, gas stoves, etc., must be suitably placed. Closets, arranged to hold stills, condensers, dishes, kettles, funnels, measures, etc., must be provided, whilst working counters, having either wooden tops covered with sheet-lead, or slate tops, must be arranged so as to obtain the greatest number of advantages. Care should be exercised to have the floor, whether of stone or of brick, laid in cement, and slant gradually, so that when it is washed the water will naturally run towards the waste-pipe, which should be located in one corner. If a stone or brick floor is inadmissible, an ordinary board floor, covered with sheet-zinc in those portions likely to become wet, can be made to answer. The following illustrations will serve to give some idea of the general plan of a pharmacist's small working laboratory. The special apparatus is, of course, not figured, as it would interfere with the view of the general arrange-

ment of the counters, etc. For a detailed description of the apparatus the reader is referred to the illustrations in the previous chapters and to the descriptions of the various processes of Operative Pharmacy.

The illustrations represent the counter and apparatus for the four sides of the room. Fig. 362 represents the northern side. This is

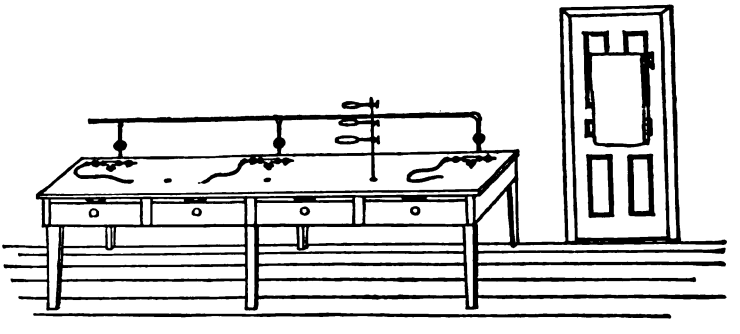
FIG. 362.



Northern side of laboratory.

devoted to the larger operations of evaporation, distillation, etc. The steam boiler, copper kettles, still, sink, etc., being here, a steam-pipe from the boiler may be run into the store for heating purposes or to supply steam for small kettles, water-baths, etc., there. Fig. 363 repre-

FIG. 363.

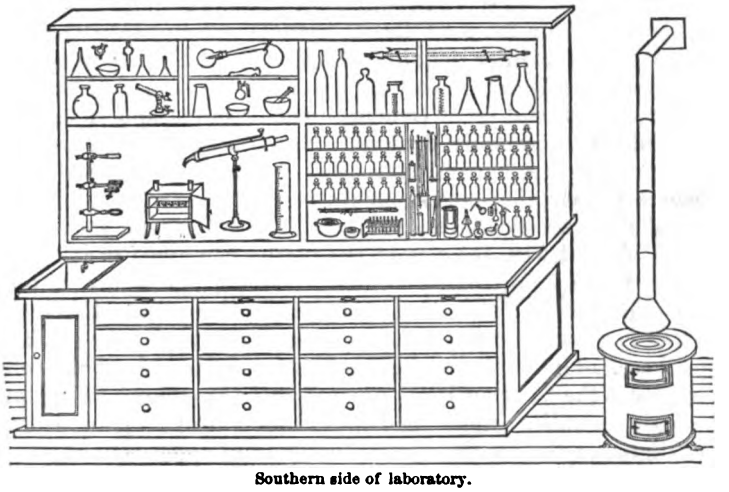


Eastern side of laboratory.

sents the eastern side, the most prominent object being a work-table, with gas and steam attachments. The retort-stand, shown in Fig. 152, may be used in either of the three holes in the counter, or it may be unscrewed and put away in pieces. Four large drawers and slides are seen in this counter. An adjustable vise might occupy space at one

end, and at least one of the drawers should be set apart for tools of general utility, as hatchet, hammer, saw, plane, chisel, etc. The other drawers may contain corks, bladder, twine, spatulas, scoops, glass

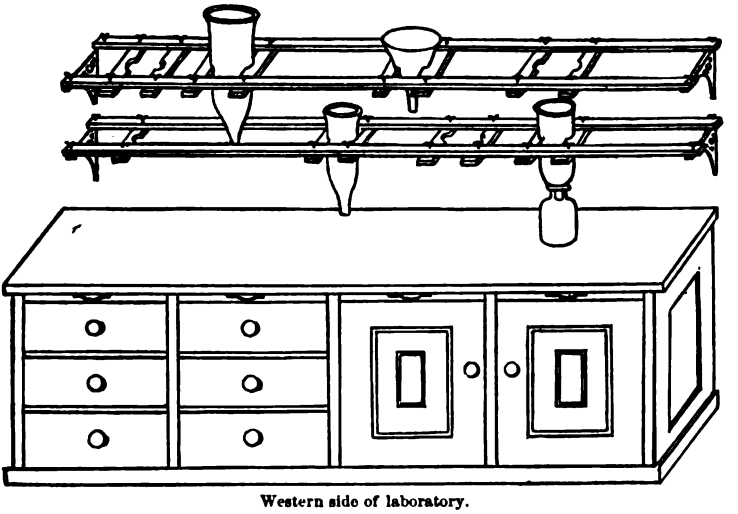
FIG. 364.



Southern side of laboratory.

tubing, cork-cutters, etc., and other articles employed in flask operations, small distillations, etc., since this counter will be used for purposes of this kind. Fig. 364 is the counter, with a sheet-lead top, used for chemical work, testing, etc. It should be on the south side, so that the

FIG. 365.



Western side of laboratory.

northern light shall fall directly on it. A small sink at one end will be a convenience. Appropriate drawers, slides, and a closet for holding chemical apparatus are also provided. Fig. 365 represents the phar-

maceutical counter, with the percolating stand (see Fig. 315) above it: two large closets to hold the percolators when not in use, and six drawers, with slides, will complete the arrangement of this counter.

The Cellar.—This usually-neglected locality should receive as much attention as the more favored portions of the store: it should be placed in charge of one or more of the assistants, and the responsibility for keeping it in good order definitely fixed. Good light is generally difficult to obtain, and care is necessary in the use of gas-lights, lanterns, etc. The floor should be of cement, stone, or brick, and, above all, the cellar should be thoroughly drained. Good facilities for lowering and hauling heavy boxes, barrels, and packages should be provided, whilst the stock of prescription-bottles should be kept in covered bins arranged on deep shelves, the doors being hinged from below, and each bin being distinctly labelled with the size of the bottles contained in it. In most stores the heating apparatus, whether it be a furnace or a portable heater, is located in the cellar; and the position of the heater in the cellar will largely determine the proper arrangement of the stock which is kept there. Undoubtedly the most useful feature about the cellar of a pharmacy is the fact that it affords a suitable place for keeping surplus stock, heavy or bulky articles, and those which are perishable if exposed to heat, light, or the too dry atmosphere of the upper rooms.

The stock of mineral waters, or of liquids which are capable of freezing, should be kept near enough to the heater to prevent an accident arising from too low a temperature in winter, whilst ointments, cerates, volatile oils, ethereal and alcoholic liquids, etc., should be placed in the cooler portions of the cellar. If a fire-proof vault made of stone or brick can be provided, it will be found a great convenience for keeping the latter class of preparations. The capacities of the cellar should be made an object of study, and a particularly cool spot should be selected in which to keep the ointments. If this should happen to be in an inconvenient place, or too far away from the steps leading from the store, one of the stock closets in the store may be converted into a dumb-waiter and lowered into a pit dug in the cellar: when an ointment is needed, the dumb-waiter can be easily hauled up, secured, and, after the object is accomplished, lowered into the cooler atmosphere.

The carboys containing acids, etc., are generally regarded as cumbersome and unwieldy objects: they may be stored on skids in the least valuable portion of the cellar. The method of pouring from a carboy is by the use of J. W. Tuft's carboy-trunnions (see page 404).

The custom of dispensing carbonated beverages has an advantage which is frequently overlooked,—namely, the fact that the fountains are efficient fire-extinguishers. A line of gas-pipe extending the whole length of the cellar, with suitable outlets, would not be an expensive investment, and yet in case of fire in the cellar it would be easy to form an attachment with a fountain of "soda-water" and thus convey a stream to the locality of the fire. The small portable steel fountains now in use would in many cases do away with the necessity for the length of gas-pipe, for they could be dragged to the fire, and their contents would prove very effective if used in time.

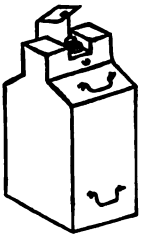
One rule should be rigidly insisted upon in the care of the stock in

the cellar, and that is that when a box of empty bottles or mineral water, or any boxed package, is opened, the contents should be distributed to the bins or places assigned for them, and the empty box and litter immediately removed.

Dampness and mould, which are generally so destructive to the stock kept in the cellar, may be avoided by ventilation. A change of air can always be secured by opening windows in the opposite ends of the cellar, and the musty odors so frequently noticed will rapidly disappear if attention is paid to ventilation.

The stock of liquids is usually kept in demijohns and large green-glass bottles: these should be arranged on shelves, the larger packages on the lower shelves. The wooden-covered glass demijohns and tinned-iron cans, known as transportation cans and demijohns, are very useful in this connection (see Fig. 366). *Great care must be taken, however, in the use of tinned-iron cans for pharmaceutical liquids:* it is not safe to store acid, alkaline, or corrosive liquids in them, nor those containing tannin, on account of their injurious action on the tinned iron. The safest plan is to limit the use of cans to oils, glycerin, fatty bodies, and syrups, which contain nothing capable of acting on the tinned iron. The large containers should be labelled in two ways: the officinal name should be stencilled plainly upon the wooden side which is most prominent, and in addition there should be a tag properly labelled and tied to the handle; upon the reverse side of this tag the date showing when the contents were made, with any other useful notes or data, should be placed. The half-gallon and smaller stock-bottles should be labelled distinctly with large letters: a serviceable label is made by using heavy manilla paper, and instead of an ordinary pen a camel's-hair brush or a piece of pine wood whittled to a flat, stub point like a German-text pen, dipped into black asphalt varnish, may be used to make the letters.

FIG. 366.



Container for stock liquids.

CHAPTER LXIV.

PRESCRIPTIONS.

THE word prescription is derived from the Latin word *præscriptio* (*præ*, "before," and *scribo*, "I write"). It may be defined as the formula which a physician writes, specifying the substances he intends to be administered to a patient.

The Latin language is preferred here in writing prescriptions, as it is also in Great Britain, Germany, and other European countries. The advantages of the use of Latin in designating the ingredients of the prescription are obvious: 1. It is the language of science, and is understood, to a greater or less extent, throughout the civilized world; in addition, it is a dead language, and therefore not subject to the changes that are common to all living forms of speech. 2. The Latin names for medicines are distinctive, and very nearly the same in all countries. 3. It is frequently necessary, and always advisable, to withhold from a patient the names and properties of the medicinal agents administered: this can usually be effected by the use of the Latin technical terms.

The Parts of a Prescription.—For the purpose of examination or study a model prescription may be divided into six parts: 1. *The superscription, or heading.* 2. *The name of the patient.* 3. *The inscription, or the names and quantities of the ingredients.* 4. *The subscription, or the directions to the compounder.* 5. *The signa (mark), or the directions for the patient.* 6. *The name or initials of the physician, with the date.*

1. **The Superscription, or Heading.**—This invariably consists, in Latin prescriptions, of the symbol ℞, which is an abbreviation of the word *recipe* ("take"), the imperative of the Latin verb *recipio*. In French prescriptions the letter *P*, the initial letter of the word *prenez* ("take"), is used.

The use of the inclined stroke upon the tail of the ℞ is traced to a custom, common in the ancient days of superstition, of placing at the top of the prescription an abbreviation, called an invocation, which represented a prayer to a favorite deity. The sign of Jupiter (♃), the chief mythological divinity of the ancient Romans, was usually employed. This was gradually replaced by the letter R; but the last stroke of the symbol of the all-powerful Jove has not yet been surrendered, and it remains as an ornament to the superscription to the present day.

2. **The Name of the Patient.**—This is frequently omitted from the prescription through inattention. It should always be placed at the top of the prescription, and should be transferred to the label by the com-

pounder. Serious accidents have sometimes occurred through neglect of this direction, as when an adult dose of a medicine has been given to a child, owing to the similarity of the appearance of an adult's and a child's medicine, and the name of the patient not appearing on either label.

3. **The Inscription, or the Names and Quantities of the Ingredients.**—This part of the prescription is undoubtedly the most important of all, and requires the greatest amount of care. The officinal names (see page 27) of the ingredients should always be used for designating those which are officinal. A model prescription, if it is of the compound class, is presumed to embrace the following: 1. The *basis*, or chief active ingredient. 2. The *adjuvant*, or aid to the basis, to assist its action. 3. The *corrective*, which is intended to qualify the action of the basis and adjuvant. 4. The *vehicle*, the ingredient which serves to "carry all," or hold them together, dilute them, and give to the whole the proper consistence, form, and color. This is sometimes called the *diluent*.

The ingredients are sometimes written down by the physician in the order given above; but this rule is frequently deviated from, and they follow in the order of their importance. This is a matter of small moment to the pharmacist, however, for he always has to consider solubility, compatibility, and other necessary considerations which determine the order, if the prescription is to be compounded properly.

Many prescriptions contain but one or two ingredients, there being no especial need of a corrective, vehicle, or diluent, the tendency of modern therapeutics being against polypharmacy and in the direction of simple and concentrated remedies, or those having positive effects. There are many advantages to be derived, however, from the combination of ingredients, even when these have similar medicinal action.

The name of each ingredient, and the quantity attached to it, should occupy but one line, and great care should be observed in abbreviating, to see that the abbreviation is distinctive and not liable to be mistaken for an article not intended by the writer. The cabalistic characters in present use, designating the quantities in a Latin prescription, must be very plainly written, if serious errors are to be avoided.

The method of ascertaining the quantities of each of the ingredients generally followed by physicians, is first to write down the names of the ingredients in the proper order, each on a separate line, without affixing the quantities; then having decided upon the total number of doses that are to be given, or the total number of pills, lozenges, capsules, suppositories, etc., by multiplying this by the amount proper to give for the single dose the quantity of the ingredient is obtained.

METHOD OF ALLOTTING QUANTITIES.

Parts in Order.	℞ Ingredients.	No. of Doses.	Multiplied by	Single Dose.	Quantity of each Ingredient.
Basis	Chloralis	16	×	7½ gr.	ʒij
Adjuvant . .	Potassii Bromidi . .	16	×	15 gr.	ʒiv
Corrective . . .	Syrupi Zingiberis .	16	×	fʒss	fʒi
Vehicle	Syrupi	16	×	fʒiss	fʒiij

Symbolic Characters used in Latin Prescriptions.—Although the subject of weights and measures is treated in the earlier chapters of this work, the special characters used in prescriptions, with their values attached, may be appropriately recalled in this connection: they are as follows:

℥, *Minim*, $\frac{1}{60}$ of a fluidrachm.
gtt., *Gutta*, a drop; plural, *guttæ*, drops.
℈, *Scrupulus*, a scruple (20 grains).[1]
ʒ, *Drachma*, a drachm (60 grains).
f ʒ, *Fluidrachma*, a fluidrachm (60 minims).
℥, *Uncia*, a troyounce (480 grains).
f ℥, *Fluiduncia*, a fluidounce (8 fluidrachms).
℔, *Libra*, a pound, rarely used (in prescriptions, 5760 grains).
O, *Octarius*, a pint (16 fluidounces).
gr., *Granum*, a grain; plural *grana*, grains.
ss., *Semis*, a half.

The Roman numerals are used to designate quantities,—i, ij, iij, iv, v, vi, vij, viij, ix, x, xx, xxx, xl, l, lx, lxx, lxxx, xc, c, etc. These are always written after the ingredient, as Sacchari ʒiv. Care should be taken to dot the i's in each case, to avoid possible errors.

4. **The Subscription, or the Directions to the Compounder.**—The progress made in pharmacy is well shown by the present custom of omitting specific directions to the compounder. In the vast majority of prescriptions the subscription is contracted to a single letter or word, as *M.*, or *misce, S.*, or *solve, F., fiat*, etc. The physician relies upon the skill of the pharmacist, and generally gives no specific directions.

5. **The Signa, or Directions for the Patient,** sometimes called Signatura, is usually abbreviated *Sig.* or *S.* Formerly these directions were written in Latin, but this is rarely the case now, except in Great Britain. There is, indeed, no good reason for writing them in Latin. The Latin which is in common use in prescription-writing is idiomatic, and, although the ordinary rules of Latin grammar are generally applicable to it, many of the terms have a special meaning, and it differs in several respects from classical Latin, and hence has to be a special object of study. The directions should be known to the patient, and should be written in the vernacular on the label in a clear, distinct hand. The careless habit of not specifying the directions, by writing "As dir." for "as directed" or "use as directed," is greatly to be deprecated. Frequently the patient forgets the verbal directions, or misunderstands them, and asks the pharmacist, "How is this medicine to be taken?" The answer must of necessity be as worthless as the direction, unless the pharmacist by skilful questioning can cause the directions to be recalled by the patient. Then, again, the dose of the prescription gives the only clue to its safety. Without knowing it, the pharmacist cannot be held responsible for not detecting an error. The patient, even if he remembers at the time the verbal directions, may soon forget them, and afterwards take a double dose by mistake. The directions for the patient should be written in full, explicitly, and in plain English.

[1] This weight is rapidly passing out of use. It is quite as convenient to write gr. xx, and this is not likely to be mistaken for ʒ, as ℈ is.

6. The Name or Initials of the Physician, with Date.—The name of the prescriber is rarely signed in full, particularly since the very general use of printed prescription-blanks, which contain not only the full name and address of the physician but also his office-hours. It is very necessary sometimes to communicate quickly with the physician in case of error or ambiguity, and, when printed blanks are not used, the name and address of the prescriber should be written in full.

Unusual Doses in Prescriptions.—It is to be regretted that some uniform system of indicating unusual doses has not been adopted by physicians. Occasions frequently arise where the patient, either from becoming habituated to its use, or from some other cause, will tolerate an excessive or ordinarily poisonous dose of a remedy. A careful pharmacist always hesitates to compound such a prescription if the dose is not especially marked as unusual, and delays necessarily occur. The most satisfactory method of indicating such a dose is that of underscoring the quantity deemed unusual, as shown in the following:

℞ Morph. Sulph. gr. vi;
Syrup. Limonis ʒij;
Aquæ q. s. ft. ʒi.
Sig. A teaspoonful every two hours until relieved.

Other marks are sometimes used,—the exclamation-mark (!), for instance, or Q. R. (*quantum rectum*). These are not so distinctive as underscoring, and are open to the objection that in handwriting, which is very apt to be defective, they are likely to puzzle or mislead the pharmacist by being mistaken for some other parts of the prescription. A heavy black line under the unusual dose cannot be mistaken.

One of the best works recently published upon prescription Latin is the Latin Grammar of Pharmacy, by Joseph Ince, London. The student will be well repaid by a careful perusal. The following Latin prescription from Whitla's Elements, with the grammatical analysis, is so thoroughly illustrative that it is inserted in its entirety.

℞		Superscription.
(Basis.)	*Pot. Acet.* ʒv.	Inscription.
(Adjuvant.)	*Tinct. Digitalis* ʒj.	
(Corrective.)	*Syr. Aurantii* ʒj.	
(Vehicle.)	*Decoct. Scoparii ad* ʒviij.	
M., ft. mist.		Subscription.
Cpt. cochl. mag. ii. 4ta q.q. hora ex paul. aquæ.		Signa.

Without abbreviations or contractions it would read thus:

Recipe
Potassæ Acetatis drachmas quinque.
Tincturæ Digitalis drachmam unam.
Syrupi Aurantii unciam unam.
Decocti Scoparii ad uncias octo.
Misce, fiat mistura. *Capiat cochlearia duo magna quarta quâque horâ ex paululo aquæ.*

The student will find benefit from a careful study of the following page, in which the Latin of the above prescription is arranged according to the English idiom, and each word parsed and translated.

Recipe Potassæ Acetatis drachmas quinque.

℞ (Recipe).	v. irr. tr. imp. m. 2d per. s., to agree with its nom. Tu—"thou" (understood). Recipi-o, recepi, receptum, recipere. From re and capio.	Take thou
v (quinque).	num. adj. indec. ac. pl. qual. and agreeing with drachmas.	five
ʒ (drachmas).	n. f. ac. pl. Drachma, -æ.	drams
Acet. (acetatis).	n. f. gen. s. qual. drachmas. Acetas, -atis.	of acetate
Pot. (potassæ).	n. f. gen. s. qual. acetatis. Potassa, -æ.	of potash.

Recipe Digitalis Tincturæ drachmam unam.

℞ (Recipe).	(understood.)	Take thou
j (unam).	num. adj. ac. s. qual. and agreeing with drachmam. Unus, -a, -um.	one
ʒ (drachmam).	n. f. ac. s. gov. by recipe. Drachma, -æ.	dram
Tinct. (tincturæ).	n. f. gen. s. qual. drachmam. Tinctura, -æ.	of the tincture
Digit. (digitalis).	n. f. gen. s. qual. tincturæ. Digitalis, -is.	of digitalis.

Recipe Aurantii Syrupi unciam unam.

℞ (Recipe).	(understood.)	Take thou
j (unam).	(Parsed as before.)	one
℥ (unciam).	n. f. ac. s. gov. by recipe. Uncia, -æ.	ounce
Syr. (syrupi).	n. m. gen. s. qual. unciam. Syrupus, -i.	of syrup
Aur. (aurantii).	n. neut. gen. s. qual. syrupi. Aurantium, -ii.	of orange peel.

Recipe Decocti Scoparii ad uncias octo.

℞ (Recipe).	(understood.)	Take thou
Ad.	prep. used adverbially.	up to
viij (octo).	num. adj. indec. qual. uncias.	eight
℥ (uncias).	n. f. ac. pl. gov. by recipe. Uncia, -æ.	ounces
Decoct.[1] (decocti).	n. neut. gen. s. qual. uncias. Decoctum, -i.	of the decoction
Scop. (scoparii).	n. masc. gen. s. qual. decocti. Scoparius, -ii.	of broom.

Misce, fiat mistura.

M. (misce).	v. trans. imp. m. p. t., agreeing with and governed by Tu (understood). Misceo, -ui, mixtum or mistum, miscere.	Mix you, or mix.
Mist. (mistura).	n. f. nom. s., governing fiat. Mistura, -æ.	Let the mixture
Ft. (fiat).	v. used as passive of facio, pres. sub. 3d s. Used as imp. gov. by and agreeing with mistura. Fio, factus sum, fieri; to be made or become.	be made.

Capiat cochlearia duo magna quarta quâque horâ ex paululo aquæ.

Cpt. (capiat).	irr. v. tr. sub. m. pr. t. 3d per. s., agreeing with and gov. by Is—"he" (understood). Capio, cepi, captum, capere, the present subjunctive used as an imperative.	He may take, or let him take,
ij (duo).	num. adj. ac. pl. neut. qual. and agreeing with cochlearia. Duo, -æ, -o.	two
Mag. (magna).	adj. ac. pl. neut. qual. and agreeing with cochlearia. Magnus, -a, -um.	large
Coch. (cochlearia).	n. ac. pl. neut., gov. by capiat. Cochleare, -is.	tablespoonfuls
q.q. (quâque).	pron. indef. abl. s., qualifying and agreeing with horâ. Quisque, quæque, quodque.	at each
4ta (quarta).	num. adj. abl. s., qualifying and agreeing with horâ. Quartus, -a, -um.	fourth
Horâ.	n. f. abl. s. Hora, -æ.	hour
Ex.	prep.	out of
Paul. (paululo).	adj. abl. s. Used as a noun, gov. by ex. Paululus, -a, -um.	a little
Aq. (Aquæ).	n. f. gen. s. qual. paululo. Aqua, -æ.	of water.

[1] Some authorities would put Decoct. in the accusative, governed by recipe. In the same way, where the student meets Aquæ ad ʒ in the different prescriptions and formulæ throughout this work, he may substitute Aquam ad ʒ; but this latter is by no means so idiomatic as Aquæ ad ʒ.

Abbreviations are necessary in writing prescriptions, and they are universally employed. Great care must be taken, however, to avoid ambiguities, which may mean death to the patient. Usually, the careful pharmacist gathers from the directions and the quantities the information which guides him into safety. A few examples of defective abbreviations are appended, a number of which are taken from Pareira's Physician's Prescription-Book.

Acid. Hydroc.	May mean Acidum Hydrochloricum or Acidum Hydrocyanicum.
Aconit.	Aconitine. Aconiti Radix. Aconiti Folia.
Ammon.	Ammonia (alkali). Ammoniac (gum-resin).
Aq. Chlor.	Aqua Chlori. Aqua Chloroformi.
Aq. Fontis.	May often be read Aqua Fortis.
Calc. Chlor.	Chloride of Calcium. Chlorinated Lime.
Chlor.	Chlorine. Chloroform. Chloral.
Emp. Lyt.	Emp. Lytharg. (lead plaster,—old name). Emp. Lyttæ (blistering plaster).
Ext. Col.	Extractum Colchici. Extractum Colocynthidis.
Hyd. Chlor.	Calomel. Corrosive Sublimate. Chloral Hydrate.
Hydr.	Hydrargyrum (mercury). Hydras (hydrate). Hydriodas (hydriodate). Hydrochloras (hydrochlorate). Hydrocyanas (hydrocyanate).
Mist. Ammon.	Ammonia Mixture. Mixture of Ammoniac (gum-resin).
Potass. Hyd.	Hydrate of Potash (caustic potassa). Hydriodate of Potash (iodide of potassium).
Sod. Hypo.	Hyposulphite of Sodium. Hypophosphite of Sodium.
Sod. Sulph.	Sulphate of Sodium. Sulphite of Sodium. Sulphide of Sodium.
Sulph.	Sulphur. Sulphide. Sulphate. Sulphite.
Zinci Phosph.	Phosphate of Zinc. Phosphide of Zinc.

The above list might be indefinitely prolonged. Sufficient has been clearly shown, however, to convince even the most sceptical practitioner of the grave danger of careless abbreviation. The following table of abbreviations, terms, etc., used in prescriptions will be of service to the pharmacist, by enabling him to translate some of the technical phrases used in writing prescriptions:

Word or Phrase.	Contraction.	Meaning.	Word or Phrase.	Contraction.	Meaning.
A, āā		Of each.	Adjacens	Adjac.	Adjacent.
Abdomen	Abdom.	The belly.	Ad libitum	Ad lib.	At pleasure.
Absente febre	Abs. febr.	In the absence of fever.	Admove, admoveatur, admoveantur	Admov.	Apply, let it be applied, let them be applied.
Accurate		Accurately.			
Ad	Ad	To, up to.			
Ad duas vices	Ad 2 vic.	At twice taking.	Adstante febre	Adst. febre.	When the fever is on.
Ad secundum vicem		To the second time.	Adversum	Adv.	Against.
Ad tertiam vicem		For three times.	Aggrediente febre	Aggred. febre.	While the fever is coming on.
Adde, or addantur, addendus, addendo	Ad. or add.	Add, or let them be added, to be added, by adding.	Agitato vase		The vial being shaken.
			Aliquot		Some.
			Alter		The other.
Ad defectionem animi	Ad def. animi.	To fainting.	Alternis horis		Every other hour.
			Aluta		Leather.
Ad gratam aciditatem	Ad grat. acid.	To an agreeable sourness.	Alvo adstricta	Alv. adst.	The bowels being confined.
Adhibendus		To be administered.	Alvus		The belly.
			Amplus		Large.

Word or Phrase.	Contraction.	Meaning.	Word or Phrase.	Contraction.	Meaning.
Ana	A., āā.	Of each.	Colaturæ	Colatur.	To, or of, the strained liquor.
Aqua	Aq.	Water.			
Aqua astricta	Aq. astr.	Frozen water.	Colatus	Colat.	Strained.
Aqua bulliens	Aq. bull.	Boiling water.	Coletur	Colet.	Let it be strained.
Aqua communis	Aq. comm.	Common water.	Colentur	Colent.	Let them be strained.
Aqua fervens	Aq. ferv.	Hot water.	Collutorium	Collut.	A mouth-wash.
Aqua fluviatilis	Aq. fluv.	River water.	Collyrium	Collyr., Coll.	An eye-wash.
			Coloretur		Let it be colored.
Aqua fontalis (or fontis or fontana)	Aq. font.	Spring water.	Compositus	Comp.	Compounded.
			Concisus		Cut.
			Confectio	Conf.	Confection.
Aqua marina	Aq. mar.	Sea water.	Congius	Cong.	A gallon.
Aqua nivalis	Aq. niv.	Snow water.	Conserva	Cons.	A conserve; also keep (thou).
Aqua pluviatilis (or pluvialis)	Aq. pluv.	Rain water.			
			Continuantur remedia	Cont. rem.	Let the medicines be continued.
Aut		Or.	Contusus		Bruised.
Balneum arenæ	B. A.	Sand-bath.	Coque, Coquantur	Coq.	Boil, let them be boiled.
Balneum mariæ or maris	B. M.	A salt-water bath.	Coque ad medietatis consumptionem	Coq. ad med. consump.	Boil to the consumption of half.
Balneum vaporosum or vaporis	B. V.	A vapor-bath.			
			Coque secundum artem	Coq. S. A.	Boil according to art.
Balsamum	Bals.	Balsam.	Coque in sufficiente quantitate aquæ	Coq. in S. A.	Boil in a sufficient quantity of water.
Barbadensis	B.B., B.B.S.	Barbadoes.			
Bene		Well.			
Bibe	Bib.	Drink.	Cor, cordis		The heart.
Biduum		Two days.	Cortex	Cort.	The bark.
Bis		Twice.	Coxa		The hip.
Bis in die	Bis in d.	Twice a day.	Cras, Crastinus	Crast.	To-morrow.
Bis indies	Bis in d.	Twice a day.			
Bolus	Bol.	A large pill.	Cras mane sumendus		To be taken to-morrow morning.
Bulliat, bulliant	Bull.	Let boil.			
			Cras nocte		To-morrow night.
Butyrum	But.	Butter.	Cras vespere		To-morrow evening.
Cæruleus	Cærul.	Blue.			
Calefactus		Warmed.	Crastinus		For to-morrow, early.
Calomel	Cal.	Mild chloride of mercury.	Cujus, Cujuslibet	Cuj.	Of which, of any.
Calomelas		Calomel, or mild chloride of mercury.	Cum	C.	With.
			Cyatho theæ		In a cup of tea.
Capiat	Cap.	Let him (or her) take.	Cyathus, vel Cyathus vinarius	Cyath., C. vinar.	A wineglass, from one-half to two fluidounces.
Caute		Cautiously.			
Charta	Chart.	Paper.	Da, detur	D., det.	Give, let be given.
Chartula		Small paper.	De		Of, or from.
Cibus		Food.	Deaurentur pilulæ	Deaur. pil.	Let the pills be gilt.
Cochlear or cochleare, Cochleatim	Coch., Cochleat.	A spoonful, by spoonfuls.	Debita spissitudo	Deb. spiss.	A proper consistence.
Cochleare amplum	Coch. amp.	A tablespoonful.	Debitus		Due, proper.
			Decanta	Dec.	Pour off.
Cochleare magnum	Coch. mag.	A large spoonful (about half an ounce).	Decem, Decimus		Ten, the tenth.
			Decoctum	Decoct.	A decoction.
Cochleare medium or modicum	Coch. med.	A dessertspoonful (about two fluidrachms).	Decubitus	Decub.	Lying down.
			De die in diem	De d. in d.	From day to day.
Cochleare parvum	Coch. parv.	A teaspoonful (about one fluidrachm).	Dein		Thereupon.
			Deglutiatur	Deglut.	May or let be swallowed.
Coctio	Coct.	Boiling.	Dejectiones alvi	Dej. alv.	Stools.
Cola	Col.	Strain.			

Word or Phrase.	Contraction.	Meaning.	Word or Phrase.	Contraction.	Meaning.
Detur in duplo		Let twice as much be given.	Fiant chartulæ xij	Ft. chart. xij.	Make 12 powders.
Dexter, Dextra		The right.	Fiat collyrium	Ft. collyr.	Make an eye-wash.
Diebus alternis	Dieb. alt.	Every other day.	Fiat confectio	Ft. confec.	Make a confection.
Diebus tertiis	Dieb. tert.	Every third day.	Fiat electuarium	Ft. elect.	Make an electuary.
Diluculo	Diluc.	At break of day.	Fiat emplastrum 6 × 4	Ft. emp. 6 × 4.	Make a plaster 6 by 4 inches.
Dilue, Dilutus	Dil.	Dilute (thou), diluted.	Fiat emplastrum epispasticum	Ft. emp. epispast.	Make a blister.
Dimidius	Dim.	One-half.	Fiat emplastrum vesicatorium	Ft. emp. vesicat.	
Directione propriâ	D. P. or direc. prop.	With a proper direction.			
Dividatur in partes æquales	D. in p. æq.	Let it be divided into equal parts.	Fiat emulsio	Ft. emuls.	Make an emulsion.
Dividendus, -a, -um		To be divided.	Fiat enema	Ft. enema.	Make an injection (for rectum).
Dolor		Pain.	Fiat gargarisma	Ft. garg.	Make a gargle.
Donec		Until.	Fiat haustus	Ft. haust.	Make a draught.
Donec alvus bis dejiciatur		Until the bowels have been twice evacuated.	Fiat infusum	Ft. infus.	Make an infusion.
			Fiat injectio	Ft. inject.	Make an injection (for urethra).
Donec alvus soluta fuerit		Until the bowels shall be opened.	Fiat lege artis	F. L. A.	Let it be made by the rules of art.
Donec dolor nephriticus exulaverit		Until the nephritic pain is removed.	Fiat linimentum	Ft. linim.	Make a liniment.
Dosis	D.	A dose.	Fiat massa	Ft. massa.	Make a mass.
Durante dolore		While the pain lasts.	Fiat massa et divide in pilulas xij	Ft. mas. div. in pil. xij.	Make 12 pills.
Eadem (fem.)		The same.			
Eburneus	Eburn.	Made of ivory.	Fiat massa in pilulas xij dividenda	Ft. mas. div. in pil. xij.	
Edulcorata	Ed.	Edulcorated.			
Ejusdem	Ejusd.	Of the same.			
Electuarium	Elect.	An electuary.	Fiat massa in trochiscos xl dividenda	Ft. mas. in troch. xl div.	Make 40 lozenges
Emesis		Vomiting.			
Enema	En.	An enema, a clyster.			
Enemata		Clysters.	Fiat mistura	Ft. mist.	Make a mixture.
Et		And.	Fiant pilulæ xij	Ft. pil. xij.	Make 12 pills.
Evanuerit		Shall have disappeared.	Fiat pulvis	Ft. pulv.	Make a powder.
Exhibeatur	Exhib.	Let it be exhibited.	Fiant pulveres xij	Ft. pulv. xij.	Make 12 powders.
Extende	Ext.	Spread.	Fiat pulvis et divide in chartulas xij	Ft. pulv. et div. in char. xij.	
Extende super alutam mollem	Ex. sup. alut. moll.	Spread thou upon soft leather.			
Extractum	Extr.	An extract.			
Fac, Fiat, Fiant	F., Ft.	Make, let it be made, let them be made.	Fiat pulvis in chartulas xij dividenda		
Fac pilulas duodecim	F. pil. xij.	Make 12 pills.			
Farina		Flour.	Fiat secundum artis regulas	F. S. A. R.	Let it be made according to the rules of art.
Fasciculus		A bundle which can be carried under the arm.	Fiat solutio	Ft. solut.	Make a solution.
			Fiat suppositorium	Ft. suppos.	Make a suppository.
Febre durante	Feb. dur.	During the fever.	Fiant suppositoria iv	Ft. suppos. iv.	Make 4 suppositories.
Febris		Fever.			
Femoribus internis	Fem. intern.	To the inner parts of the thighs.	Fiat trochisci xxiv	Ft. troch. xxiv.	Make 24 lozenges.
Fervens	Ferv.	Boiling.	Fiat unguentum	Ft. ung.	Make an ointment.
Fiat cataplasma	Ft. cataplasm.	Make a poultice.	Fiat venæsectio		Bleed.
Fiat ceratum	Ft. cerat.	Make a cerate.			

Word or Phrase.	Contraction.	Meaning.	Word or Phrase.	Contraction.	Meaning.
Fictilis		Earthen.	Inter		Between.
Filtra		Filter (thou).	Internus		Inner.
Filtram, Filtrum		A filter.	Jam		Now.
Fistula armata		A syringe fitted for use.	Julepus, Julepum, Julapium	Jul.	A julep.
Fluidus	Fl.	Liquid.	Jusculum		A broth.
Formula		A prescription.	Juxta		Near to.
Frustillatim	Frust.	In little pieces.	Kali præparatum (potassæ carbonas)	Kal. ppt.	Prepared kali, or carbonate or bicarbonate of potash.
Fuerit		Shall have been.	Lac		Milk.
Gargarisma	Garg.	A gargle.	Lana		Flannel.
Gelatinâ quâvis		In any kind of jelly.	Languor		Faintness.
Gradatim		By degrees, gradually.	Lateri dolenti	Lat. dol.	To the side that is painful.
Grana sex pondere		Six grains by weight.	Lectus		A bed.
Granum, Grana		Grain, grains.	Linimentum	Liniment.	A liniment.
Gratus		Pleasant.	Linteum		Lint.
Gutta	Gtt.	A drop.	Liquor	Liq.	A solution.
Guttæ	Gtt.	Drops.	Lotio		A lotion.
Guttatim	Guttat.	By drops.	Macera	Mac.	Macerate.
Guttis quibusdam	Gutt. quibusd.	With a few drops.	Magnus	Mag.	Large.
Harum pilularum sumantur tres	Har. pil. sum. iij.	Let three of these pills be taken.	Mane, Mane primo		In the morning, very early in the morning.
Haustus	Haust.	A draught.	Manipulus	M. or Man.	A handful.
Haustus purgans noster	H. p. n.	A purging draught made according to a practitioner's own formula.	Manus		The hand.
			Massa, Massa pilularis		A mass, a pill-mass.
			Matutinus		In the morning.
			Medius		Middle.
			Mensura		By measure.
Hebdomada		A week.	Mica panis	Mic. pan.	Crumb of bread.
Herba		An herb.	Minimum	M. or Min.	A minim.
Heri		Yesterday.	Minutum		A minute.
Hic, Hæc, Hoc		This.	Misce	M.	Mix.
			Mistura	Mist.	A mixture.
Hirudo		A leech.	Mitte, Mittatur, Mittantur		Send, let it be sent, let them be sent.
Hora	H.	An hour.			
Horâ somni	H. S. or Hor. som.	Just before going to sleep, or on retiring to rest.	Mitte sanguinem ad uncias duodecim saltem		Take away blood to 12 ounces at least.
Horâ undecimâ matutinâ		At the eleventh hour of the morning.	Modicus		Middle-sized.
Horâ decubitûs	H. D.	At the hour of going to bed.	Modo præscripto	Mod. præsc.	In the manner prescribed.
Horæ unius spatio	Hor. un. spatio.	At the expiration of an hour.	Mora		Delay.
Horis intermediis	Hor. interm.	In the intermediate hours.	More dictu, More solito	More dict., More sol.	In the manner directed, in the usual manner.
Idem		The same.	Mortarium		A mortar.
Idoneus		Proper.	Ne tradas sine nummo	Ne tr. s. num.	Do not deliver it unless paid. (Used by apothecaries as a caution to the assistant when the presence of the patient prevents the master from giving a verbal direction.)
Imprimis		First.			
Incide, Incisus	Inc.	Cut (thou), being cut.			
Indies	Ind.	From day to day, daily.			
Infunde	Inf.	Pour in.			
Infusum	Infus.	An infusion.			
Injectio		An injection.			
Injiciatur enema		Let a clyster be given.			
In pulmento		In gruel.	Necnon		Also.
Instar		As big as.	Nisi		Unless.

Word or Phrase.	Contraction.	Meaning.	Word or Phrase.	Contraction.	Meaning.
Non		Not.	Pro ratione ætatis		According to the age of the patient.
Nox, noctis		Night.			
Nucha		The nape of the neck.	Pro re nata	P. r. n.	Occasionally.
Numerus	No	Number.	Pugillus	Pug.	A pinch, a gripe between the thumb and first two fingers.
Nux Moschata		A nutmeg.			
Octarius	O.	A pint.			
Octavus		Eighth.	Pulvis, Pulverizatus	Pulv.	A powder, powdered.
Octo		Eight.	Pyxis		A pill-box.
Oleum lini sine igne		Cold-drawn linseed oil.	Quantum libet, or Quantum placet, or Quantum vis, or Quantum volueris	Q. l., Q. p., Q. v.	As much as you please.
Oleum olivæ optimum	O. O. O.	Best olive oil.			
Omni horâ, Omni bihorio, Omni quadrante horæ	Omn. hor., Omn. bih., Omn. quadr. hor.	Every hour, every two hours, every quarter of an hour.			
Omni mane		Every morning.	Quantum sufficiat, or Quantum satis	Q. s.	As much as is sufficient.
Omni nocte		Every night.			
Opus		Need, occasion.			
Ovum		An egg.			
Pannus		A rag.	Quâquâ horâ		Each hour.
Pars, partis		A part.	Quaque,	Q. Q.	Each or every.
Partes æquales	P. æ.	Equal parts.	Quaque horâ		Each hour.
			Quartus		Fourth.
Partitis vicibus	Part. vic.	In divided doses.	Quater		Four times.
			Quatuor		Four.
Parvulus		An infant.	Quibus		From which.
Coch. parvulum	Coch. parv.	A teaspoonful.	Quinque		Five.
			Quintus		The fifth.
Parvus		Little.	Quoque	Q. Q.	Also.
Pastillus, Pastillum		A little ball of paste, to take like a lozenge, etc.	Quorum	Quor.	Of which.
			Quotidie		Daily.
			Ratio		Proportion.
Pediluvium		A foot-bath.	Recens	Rec.	Fresh.
Per		Through, by.	Recipe	℞	Take.
Peractâ operatio emetici		When the operation of the emetic is finished.	Redactus in pulverem, redigatur in pulverem	Red. in pulv., redig. in pulv.	Let it be reduced to powder.
Per deliquium		By deliquescence.			
Pergo, pergere		To go on with.	Regio umbilici		The umbilical region.
Phiala prius agitata	P. P. A.	The bottle having been first shaken.	Reliquus		Remaining.
Pilula		A pill.	Repetatur, Repetantur	Rept.	Let it be repeated, let them be repeated.
Poculum, Pocillum	Pocul., Pocill.	A cup, a little cup.	Respondere		To answer.
Pondere	P.	By weight.	Retinere		To keep.
Pondus civile		Civil weight (avoirdupois weight).	Saltem		At least.
			Scatula	Scat.	A box.
			Scilicet		Namely.
Pondus medicinale		Medicinal (apothecaries') weight (obsolete).	Secundum artem, Secundum naturam	S. A., S. N.	According to art, according to nature.
Pone aurem		Behind the ear.			
Post singulas sedes liquidas		After every loose stool.	Secundus		Second.
			Sedes		The alvine evacuation.
Potus		Drink.	Semel		Once.
Præparata		Prepared.	Semis	Ss.	A half.
Primo mane		Very early in the morning.	Semidrachma	Semidr.	Half a drachm.
			Semihora	Semih.	Half an hour.
Primus		The first.	Septem		Seven.
Pro		For.	Septimana		A week.

Word or Phrase.	Contraction.	Meaning.	Word or Phrase.	Contraction.	Meaning.
Sescuncia		An ounce and a half.	Summitates		The summits or tops.
Sesquihora		An hour and a half.	Superbibendo haustum		Drinking afterwards this draught.
Sex		Six.			
Sextus		Sixth.	Supra		Above.
Si		If.	Tabella (dim. of tabula, a table)	Tabel.	A lozenge.
Signa	Sig.	Mark thou.			
Signetur nomine proprio		Let it be written upon with the proper name(not a trade name).	Talis		Such a one.
			Tempori dextro		To the right temple.
Simul		Together.	Tempus, temporis		Time or temple.
Sine		Without.			
Singularum	Sing.	Of each.	Ter		Three times.
Singulorum	Sing.	Of each.	Ter in die, or Ter die.	T. i. d., or t. d.	Three times a day.
Si non valeat	Si n. val.	If it does not answer.	Tere	Ter.	Rub.
Si opus sit	Si op. sit.	If necessary.	Tero		I rub.
Si vires permittant	Si vir. perm.	If the strength will bear it.	Tertius		Third.
			Tinctura	Tinct.	Tincture.
Sit		Let it be.	Tres		Three.
Solus		Alone.	Triduum		Three days.
Solve		Dissolve.	Tritura	Trit.	Triturate.
Solvo, solvere, Solutus		To dissolve. Dissolved.	Trochisci	Troch.	Lozenges.
			Tussis		A cough.
Somnus		Sleep.	Ultimo (or Ultima) præscriptus	Ult. præsc.	The last ordered.
Spiritus vini rectificatus		Rectified spirit of wine.			
Spiritus vini tenuis		Proof spirit.	Una		Together.
Spiritus vinosus		Ardent spirit of any strength.	Uncia		An ounce.
			Ut dictum	Ut dict.	As directed.
Statim	Stat.	Immediately.	Utendum	Utend.	To be used.
Stet, Stent	St.	Let it stand, let them stand.	Uto, uti		To make use of.
			Vas vitreum		A glass vessel.
Stratum super stratum	S. S. S.	Layer upon layer.	Vehiculum		A vehicle.
			Vel		Or.
Subactus		Subdued.	Venæsectio brachii		Bleeding in the arm.
Sub finem coctionis		When the boiling is nearly finished.	Vesper, vesperis	Vesp.	The evening.
Subinde.		Frequently.	Vices		Turns.
Sumat talem		Let the patient take one like this.	Vires		Strength.
			Vitellus		Yolk.
			Vitello ovi solutus		Dissolved in the yolk of an egg.
Sume, Sumat, Sumatur, Sumantur, Sumendus	Sum.	Take (thou), let him take, let it be taken, let them be taken, to be taken.	Vitreum vitrum		Glass.
			Vomitione urgente	Vom. urg.	The vomiting being troublesome.

Metric Prescriptions.

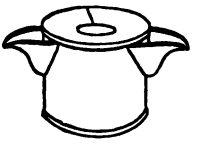
The growth of the metric system, and its partial adoption by the U. S. Pharmacopœia, 1880, have made it necessary for every pharmacist to be acquainted with the methods employed by physicians in writing metric prescriptions. It will result in a saving of time, and possibly a saving of life, if the pharmacist possesses a set of metric weights and graduates, although by the use of the tables on metric equivalents (see page 40) it will be possible to employ the ordinary weights and measures by the aid of a mental calculation.

There are two distinct methods employed in this country, which may be termed respectively the *gravimetric* and the *volumetric* method.

1. **Gravimetric Prescriptions.**—The gravimetric principle of weighing liquids is used in Germany and some other Continental countries almost exclusively. It has been adopted by the U. S. Pharmacopœia, 1880, under the name of "parts by weight;" but, although weighing liquids may be practised with advantage in the laboratory in making large quantities of preparations, and is preferable in the case of thick or adhesive liquids, it is far less convenient in compounding prescriptions than the plan of measuring the liquid ingredients. The advantage in supposed greater accuracy of weighing over measuring is more imaginary than real. A careful pharmacist will compound prescriptions just as accurately by measuring the liquids as he will by weighing them, whilst a slovenly one will be just as careless in using weights as he is in measuring liquids. The question of accuracy becomes then, practically, a "personal equation."

Several conveniences have been proposed in weighing liquids, which deserve notice. The Germans use a "tare-can" (see Fig. 367) for the purpose of quickly taring a bottle. It is a small metallic can having a shallow funnel-mouthed opening, with two spouts, one on each side. The bottle, or vessel, is placed on one of the scale-pans, and the tare-can, containing sufficient shot or clean dry sand to balance it, is placed upon the other. It is better, however, to use two tare-cans and pour from one to the other, the one not in use on the scale-pan receiving the excess of shot, or supplying the deficiency, as the case requires. Troemner's prescription scale for weighing liquids will be found very useful in this connection (see Fig. 12). The pans are solid, and a graduated bar running parallel with the scale-beam is supplied with a sliding weight, which is pushed along until the bottle or vessel is balanced.

FIG. 367.



Tare-can.

2. **Volumetric Prescriptions.**—In these the gramme is replaced by the cubic centimetre, which has been very appropriately termed *fluigramme* by Mr. A. B. Taylor. The principal reason for preferring the volumetric method is that the physician has the means of more readily calculating and apportioning the number of doses in the prescription. *Liquid medicines are never administered by weight*, but always by teaspoonfuls, tablespoonfuls, or other convenient measure. In some liquids there is a wide difference between their weight and their volume, as the specific-gravity tables abundantly show. A teaspoonful of ether weighs forty-one grains, whilst a teaspoonful of chloroform weighs eighty-five grains (more than twice as much): hence the physician cannot disregard specific gravity. In prescribing gravimetrically and administering volumetrically he must constantly bear in mind these differences, at least approximately. Mistakes are very likely to arise in making these calculations, mentally, at the bedside of a patient: hence it is far better to avoid them by *prescribing the medicines by the same method as that by which they are dispensed and administered, namely, volumetrically*, and thus preserving that harmony of relation which is

conducive to safety. If volumetric analysis is preferred to stathmetic or gravimetric analysis in the U. S. Pharmacopœia because of its greater convenience and at least equal accuracy, why should not liquids be measured rather than weighed in pharmaceutical operations in which extreme accuracy is comparatively of less importance?

The following examples illustrate the forms of metric prescriptions most frequently used. Form A is preferable, for the reasons stated:

Form A.

℞ (*Volumetric.*)

	Gm. and C.c.	
Quininæ Sulph.	1	016
Strych. Sulph.		
Ext. Glycyrrh. Fld.	4	
Syrupi	60	

A teaspoonful three times a day.

℞ (*Gravimetric.*)

Hydrarg. Chlor. Mit.		5
Pulv. Aloes	2	
Pulv. Rhei	1	5

Make twenty pills.

The advantages of the decimal line are that the decimal dot is abolished, with its dangerous complications, for a spot or a fly-speck on the prescription-paper may increase or decrease the quantity of an ingredient *ten times*, and the use of the decimal line is familiar to all who use a dollar and cents column.

Form B.

℞ (*Gravimetric.*)

Quininæ Sulph.	1.
Strych. Sulph.	.016
Ext. Glycyrrh. Fld.	4.
Syrupi	60.

A teaspoonful three times a day.

℞ (*Gravimetric.*)

Hydrarg. Chlor. Mit.	.5
Pulv. Aloes	2.
Pulv. Rhei	1.5

Make twenty pills.

This form is used frequently, because of the familiarity with the arithmetical method of using a dot to denote a decimal fraction; and where metric prescriptions are altogether in use, as in Continental Europe, there is no necessity for indicating the denomination, gramme being always understood.

Form C.

℞ (*Volumetric.*)

Quininæ Sulph.	1.	Gm.
Strych. Sulph.	.016	Gm.
Ext. Glycyr. Fld.	4.	C.c.
Syrupi	60.	C.c.

A teaspoonful three times a day.

℞ (*Gravimetric.*)

Hydrarg. Chlor. Mit.	.5	Gm.
Pulv. Aloes	2.	Gm.
Pulv. Rhei	1.5	Gm.

This form is an improvement on Form B, and would be far superior to it for use in this country, where prescriptions written in the old systems will long continue to be used; for next to writing out in full the word *gramme*, the indication of the unusual quantity by underscoring will prevent its being mistaken for *grain*.

FAULTS IN WRITING PRESCRIPTIONS.

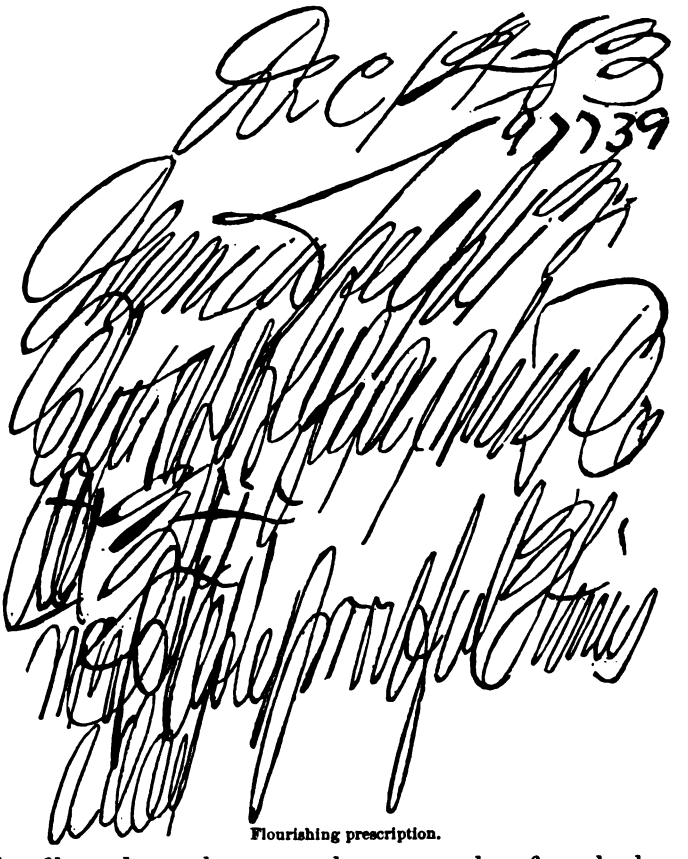
Careless Writing.—It cannot be hoped that legal enactments will ever be passed to compel practitioners to write prescriptions legibly, and yet a moderate amount of experience in compounding the prescriptions of even eminent physicians is sufficient to prove the absolute necessity of some compulsory method of securing legible prescriptions. One of the greatest annoyances of the pharmacist arises from the careless habit which some medical men have fallen into of writing prescriptions with a lead-pencil upon any old scrap of newspaper, envelope, or waste paper which they may happen to pick up.

When it is considered that the life of the patient depends upon the care with which the prescription is *deciphered*, this practice cannot be too harshly condemned.

Fig. 368 is an exact reproduction of a prescription which illustrates the evils of a flourishing style: this was presented in the ordinary course of business, and, whilst it was not difficult of interpretation to those familiar with the physician's method, it proved a puzzle to the inexperienced.

The other fac-similes (see Figs. 369, 370, 371, 372, and 373) are by no means rare specimens: they have been taken from an active pre-

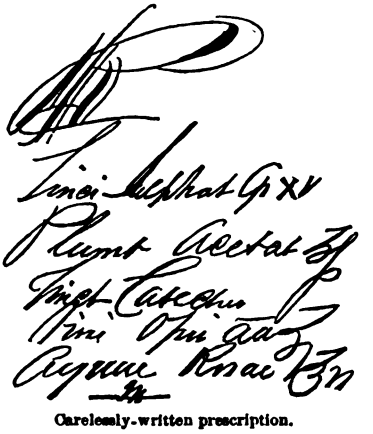
FIG. 368.



Flourishing prescription.

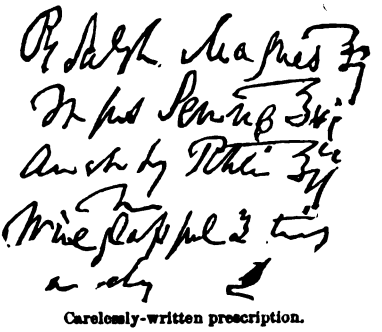
scription-file, and are shown merely as examples of carelessly-written prescriptions, and as affording a little practice for the student.

FIG. 369.



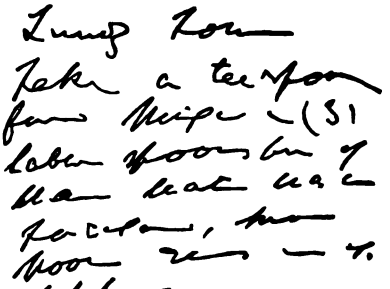
Carelessly-written prescription.

FIG. 370.



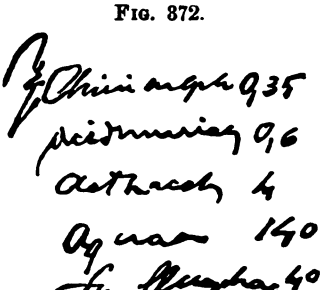
Carelessly-written prescription.

FIG. 371.



Carelessly-written prescription.

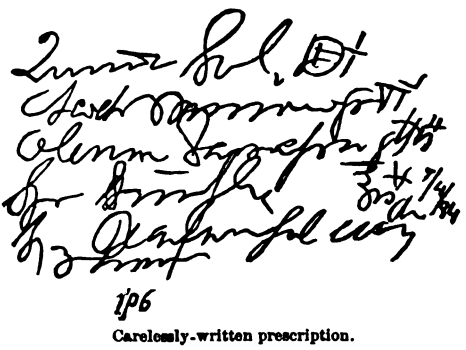
FIG. 372.



Carelessly-written prescription.

The few illustrations given here are all that we have space for: they also show the importance of writing prescriptions upon regularly printed or engraved blanks, on which the name of the physician is clearly shown, with his office-hours and address, in order that the pharmacist in case of necessity may confer with him speedily and have all doubts removed about the interpretation of the prescription. It should be remembered in this connection that it frequently happens that the physician is harassed by many annoyances and interruptions whilst writing the prescription: these circumstances, coupled with the gentlemanly instincts which all true pharmacists are credited with possessing, should exercise their proper restraining influences upon the latter whilst undertaking the mission of interviewing the physician upon a subject which is often mortifying to him.

FIG. 373.



Carelessly-written prescription.

Omissions and Errors.—If an *obvious* error or omission is detected by the pharmacist, or an unusually large or poisonous dose has been prescribed, it is generally easy to gain the requisite delay, upon the plea that the prescription will require considerable time to compound, or for some other reason which will not excite the suspicions of the patient, and in the mean time the physician may be consulted and the difficulty removed. Good judgment is necessary at all times, and where delay is entirely inadmissible there is nothing left for the pharmacist but to assume the responsibility of making the dose safe, or of supplying the omission according to his best judgment. In this case a written explanation should be sent immediately to the physician.

It is impossible to conduct an active business without encountering occasions which require the exercise of much forbearance and tact, and the reflection that both physician and pharmacist are *at all times* human,

and hence liable to err, should prevent either from indulging in expressions detrimental to the good name of the other. In the unusual instance of a physician taking umbrage when a judicious course has been followed by the pharmacist in correcting his mistake, a firm and dignified defence should be at once made by the latter, and maintained with spirit, but not in the presence of the patient if it can possibly be avoided.

In the case of omissions or errors on the part of the pharmacist, so much judgment is needed which must depend upon the circumstances surrounding each case, that it would be unsafe to offer any suggestions: generally the physician must be appealed to, and upon his skill and tact reliance must be placed. In such cases it is not often that he is found unwilling to exercise his good offices. One instance is on record showing rare tact on the part of an apothecary: it occurred before the practice of checking prescriptions became common. After renewing a mixture, he realized, just as he was in the act of handing the bottle to the nervous and suspicious old gentleman for whom it was intended, that he had omitted one of the principal ingredients: to hand it to him and permit his departure would have been professional suicide, to hesitate and take it back after the patient had watched the process of compounding, and had seen the bottle labelled and wrapped, would have excited unpleasant suspicions and have been equally disastrous. At once grasping the situation, he dropped the bottle upon the counter, allowing it to break to pieces, whilst in the act of handing it to the patient, then, with an apology for the accident, he quickly proceeded to compound the mixture over again, this time with every ingredient in it. He fully believed that any proper sacrifice should be cheerfully made to avoid loss of confidence.

The Art of Dispensing and Compounding.

The practical work embraced in the ever-varying labors of dispensing and compounding constitutes a more searching test of the adaptability and qualifications of the pharmacist than any other duty that he is called upon to perform. Careful training, tact, and much experience are needed to meet the requirements of this branch of the profession.

Receiving the Prescription or Order.—This apparently simple matter, if not carefully considered, is frequently the source of embarrassing mistakes. Very few customers, even if they are intelligent, realize the necessity of forethought or care in calling for any articles that they wish: hence it is an excellent practice for the dispenser to *repeat the order* interrogatively at the time that it is given, and obtain from the customer a clearly-expressed assent before delivering the article, lest the wrong one be dispensed. If it is a poisonous substance, the use that is to be made of it should be carefully inquired into, and in all cases a written order, properly dated and signed, should be required. The best plan is to have a regular poison book, in which the record is made. Poisonous or dangerous substances should never be dispensed to children or minors without a written order, and even then the receiver should be cautioned about the contents. Orders which require time to fill, and are to be sent out, should be carefully noted and entered.

The following prescription memorandum, which is similar to one suggested by Andrew Blair, has been in use several years by the author with excellent results. These blanks are put up in tablet form, and are filled in in the presence of the customer, or the back of the prescription may be used for noting the points when it is handed in.

MEMORANDUM.

Name.
Address.
Is it paid for?
Is it to be charged?
Is it to be called for?
Is it to be sent?
Received by
Compounded by
Number of ℞ and Price.

It is the custom in some pharmacies, when a number of prescriptions are being compounded at one time, to use what is known as the check system. Brass or nickel-plated checks or disks, numbered or lettered, are used: the customer upon handing the prescription is given a check, which he holds until the prescription is ready; the receiver marks the corresponding number or letter upon the prescription, and when he delivers the bottle or package receives back from the customer the original check containing the same number or letter. This system is not without faults; indeed, unceasing vigilance is absolutely necessary, and it is not safe to place faith in any system.

The prescription should be received with becoming dignity by the compounder, and questions answered with cheerful politeness, especial care being taken to do or say nothing that would impair confidence. Unseemly jesting, loud conversation, or boisterous mirth is entirely out of place here, whilst especial regard should be paid to the feelings of those who may have just left the sick-chamber or the bedside of one who is dear to them. In such cases every word and movement of the dispenser is often carefully watched, and, whilst ordinarily the customer may be disposed to judge seeming slowness or indifference leniently, at such times these faults become unbearable to the impatient and anxious messenger.

Reading the Prescription.—The prescription should be read over carefully, and judgment mentally pronounced, first upon the safety of the doses of the respective ingredients, and then upon their compatibility. If this reading be done in the presence of the patient, especial care should be taken that the countenance reveal nothing whatever of what may be going on in the mind of the receiver: a shrug of the shoulders, an elevation of the eyebrows, a contemptuous toss of the scrap of paper on the prescription desk, may convey to the mind of the patient a more lasting impression of the opinion of the receiver as to the merits of the prescription than open criticism. Questions are frequently asked by patients and requests made for opinions: these should always be skilfully parried. An apothecary has no right to reveal to a patient the character or the medicinal effect of the ingredients which enter into a prescription. When the names of the ingredients in the prescription are persistently demanded by the patient, the dispenser can fall back upon the expedient of frankly stating that it is a breach of etiquette to reveal the character of the ingredients, and intimating that

it shows a lack of confidence in the prescriber on the part of the patient; but, if further insisted upon, the offer to send to the physician a written request to get his permission to disclose the ingredients is generally answered by the patient with a gracious "no matter." The pharmacist, as a co-worker with the physician in the healing art, is ethically bound to sustain him and cheerfully co-operate with him, and there should be at all times a spirit of mutual respect between the members of both professions, and a feeling that each is in duty bound to protect the other from unjust censure.

In order to gain time in case of doubtful procedure, it is often good practice to write the label for the prescription as soon as it is received, and this will usually afford an opportunity to study the prescription whilst reading it. The only objection to this is that the patient very frequently misunderstands this manœuvre, and imagines that the dispenser is neglecting him and not proceeding at once to compound his prescription.

Compounding the Prescription.—The greater part of the succeeding chapter will be devoted to the details of this very important duty; in this place it is merely necessary to consider the general features. After thoroughly understanding the prescription and clearly deciphering it, a method must be quickly formulated for compounding it. In this connection, if there is any doubt about safety, the well-known aphorism, "When you do not know what to do, do nothing," has great force. The work of compounding must not go on in any feeling of uncertainty; the chance of causing death or serious consequences is too great to warrant the running of risks, and there is nearly always more safety in delay than in pushing forward doubtfully.

When a clearly-outlined plan of procedure is decided upon, the ingredients should be carefully weighed or measured and the process witnessed by a colleague. *The system of double checking prescriptions should be invariably followed wherever possible:* over-confidence and an indisposition to recognize the possibility of making a mistake have probably occasioned more loss of life in this responsible work than any other cause. Not only should the junior assistant cheerfully submit to having his work witnessed, but even the *preceptor* should insist upon one of his assistants checking off the ingredients and quantities which he has weighed or measured out himself, as a matter of principle and method. If this is not always possible, on account of there being but one present in the store, the system of single checking should be invariably practised: this is, briefly, to arrange upon the counter the shop-bottles or packages from which were taken the ingredients which entered into the prescription, and place the weights which were used immediately in front, then, when the preparation is finished, to check off from the prescription each ingredient in order, noting the weight or measure. Before permitting a prescription which is at all complicated to advance further in the process of compounding, each ingredient should be numbered in lead-pencil on the margin in the order in which it has been added. This memorandum becomes valuable when the prescription is to be renewed, because there will then be no likelihood of the renewed prescription differing from the original.

Additions or Alterations to Prescriptions by the Pharmacist.—At the present time it is the custom among physicians to hold the pharmacist responsible for the proper compounding of prescriptions intrusted to his care, and to depend upon him. Such details as the choice of the excipient, method of straining or filtering, etc., are usually not specified: indeed, with many it is a frequent practice simply to direct a solution or mixture of definite strength and rely upon the pharmacist to make it palatable. In all cases of this kind, care must be taken to make a note upon the prescription of each addition, so that in the event of renewal there may be no difference between the preparation then obtained and the original. The confidence which physicians place in pharmacists in this respect should be most sedulously guarded and every effort made to deserve and retain it. This can be done only by adhering strictly to the rule of *not permitting an alteration or addition to be made to a prescription which would affect or vitiate its proper medicinal action or interfere with the obvious intention of the prescriber.*

Numbering the Prescription.—It is the universal practice to number the prescription, and to place a corresponding number upon the label, the object being to identify the bottle or package in case of renewal and connect it with the original prescription. This apparently simple matter requires upon the part of the compounder concentration of thought to avoid errors,—one of the most frequent lapses being that of duplicating the number of the last prescription, instead of numbering it consecutively: this, in case of renewal, may lead to serious consequences, particularly if one prescription happens to be a four-ounce aconite liniment and the other a four-ounce solution for internal use of similar appearance. The duplication of the numbers is particularly liable to occur when several prescriptions are being compounded at the same time by two or more assistants. Various expedients have been proposed to obviate mistakes of duplication: one is to have a strip of paper about an inch wide numbered consecutively, rolled with the highest number inside, and placed in a round tin ointment-box which has a slit in the side to permit the end of the strip to appear; this may be hung in a convenient place and the number cut off and pasted on the prescription, or, if the location is one having a dry atmosphere, a gummed strip may be used. Another method is to arrange the numbers upon gummed sheets and bind them in book form, or glue the edges and use as tablets (see Fig. 374); in the latter case the numbers are printed in perpendicular columns, and the margins are perforated so that the outer strip from 1000 to 1009 may be torn nearly off, and each number then cut off with scissors or gently torn off as it is wanted.

FIG. 374.

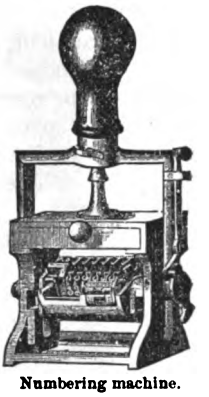
NUMBERING TABLET.			
1039	1029	1019	1009
1038	1028	1018	1008
1037	1027	1017	1007
1036	1026	1016	1006
1035	1025	1015	1005
1034	1024	1014	1004
1033	1023	1013	1003
1032	1022	1012	1002
1031	1021	1011	1001
1030	1020	1010	1000

Numbering tablet.

Consecutive Numbering Machines are also used; these are very convenient, and serve excellent purposes if they are properly and durably constructed. The best machine

known to the author is shown in Fig. 375: it is made in Vienna, and can be adjusted to number *automatically* either consecutively, repeatedly, in duplicate or in triplicate.

FIG. 375.

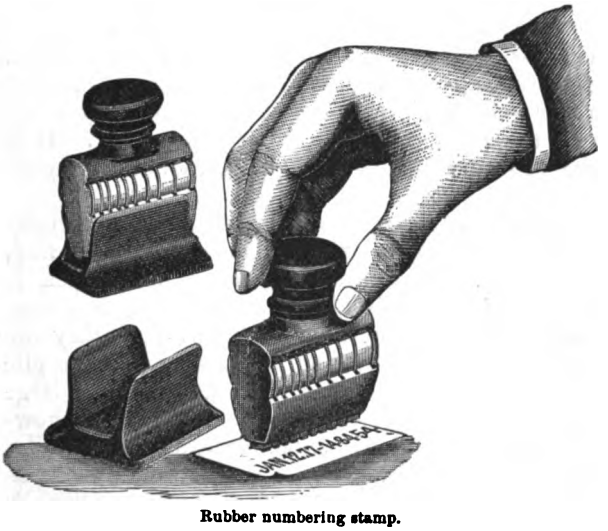


Numbering machine.

The usefulness of this machine to the pharmacist consists largely in the fact that it can be made to *number consecutively in duplicate* (13428, 13428; 13429, 13429, etc.), so that if a proper-sized machine is chosen (letter *b* is preferred) the number may be clearly and neatly printed upon *both prescription and label;* the machine may then be locked and set, so that there is not the slightest danger of variation or change in the method of numbering whilst in use. The value of a mechanical contrivance of this kind consists in its absolute freedom from mistakes, and in the entire elimination of chances of error from defective handwriting, the figures being printed from hardened steel disks, invariably producing clear and distinct impressions.

Rubber Numbering Stamps are also in use: these are cheaper than the consecutive numbering machines, and are very convenient. Fig. 376 shows one which combines with it a dater. These machines are not automatic, however: the numbers are cast upon endless rubber strips, which are rotated by toothed disks, the face of the succeeding unit appearing in its proper place at the lower opening upon moving the appropriate disk. The stand which supports the stamp is provided with an ink-pad at the bottom, on which the type rest.

FIG. 376.



Rubber numbering stamp.

Dating.—This also serves to fix the identity of a prescription, and it should never be omitted. The physician usually appends the date, but the prescription is frequently held by the patient and not presented for compounding upon the day on which it is written. As in the case of numbering, the date is most frequently written upon the face of the prescription by the pharmacist; and this should not be omitted, even though the date written by the physician be visible. The habit of dating should be firmly established, because it may prove of vital im-

portance in case of a subsequent discussion or difference of opinion. *Rubber daters* are largely used now, ribbon dating stamps being somewhat more troublesome on account of the difficulty of keeping the ribbon in order. Fig. 377 shows one of the best and cheapest forms of rubber daters.[1]

FIG. 377.

Rubber dating machine.

Pricing.—The price of the prescription must always be marked upon it: this is necessary in order to fix the sum in case of renewal. The price is usually not subject to variation, except in the case of a patient ordering a larger or smaller quantity of the prescription. In renewals, in all cases the increase or decrease should be noted distinctly, if future annoyance is to be avoided. Few occurrences are apt to create more distrust in the mind of the patient than a neglect of this precaution, the reasoning being that if the pharmacist is so careless as to have two prices for the same prescription, he probably has been careless in compounding it. The greatest objection arises, however, when the price asked is *greater* than that originally demanded.

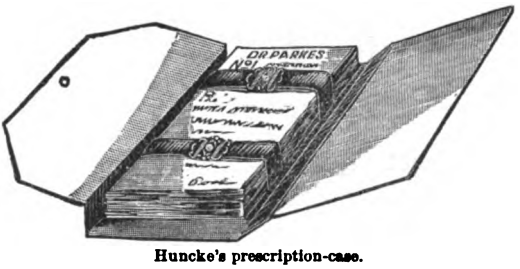
It frequently happens that physicians desire to indicate that a patient is poor and is a proper subject for charity: this is usually done by writing the letter P in the lower corner, or, if very poor, PP. It is customary and humane to regard these marks, if assured of their genuineness.

Filing, Binding, and Preserving.—There is very little uniformity of practice among pharmacists in the particulars of filing, binding, and preserving prescriptions. The usual practice is one which is most inconvenient,—*i.e.*, that of simply filing them away upon a long brass wire yearly, half-yearly, or quarterly. By this plan they are sure to become in time torn, dirty, dusty, and fly-specked, and the pile is very unsightly. The method of pasting them daily into a large invoice-book is an improvement: the objection to this plan is, however, that the backs of the prescriptions cannot be examined readily, and in an active business the unwieldy books soon accumulate so as to be an inconvenience. A ready method of binding prescriptions is furnished by the use of Mann's binder: this consists of two durable stiff covers having a wrought-iron strip riveted to the edge of each; two long screws are fastened to one of the strips; these pass through two screw-holes in the other strip, and the covers are kept in place by two adjustable brass cylinders split longitudinally in the centre, having a solid disk at the top with a screw-hole in the centre, and at the bottom the same kind of disk cut in two. The split cylinders are flared somewhat at the bottom, and are made to approach each other by a

[1] Rubber numbering and dating machines may be procured from Walker, Tucker & Co., Philadelphia.

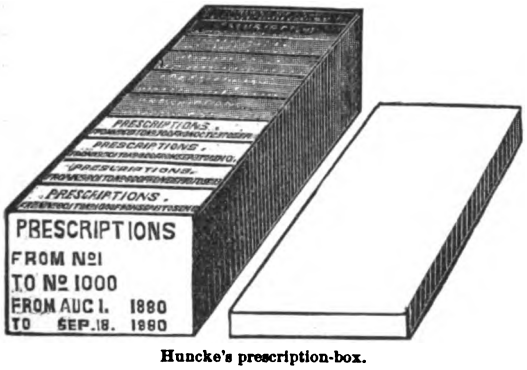
ring; by slipping this ring down, the edges of the bisected disks are brought together, and these can then be screwed down so as to hold securely; they can be instantly released, however, by pushing the ring up. The advantage of this binder is that it can be so readily converted into a temporary or a permanent binder. One month's prescriptions can be placed upon one screw by punching out a hole in the side of the prescription with a circular punch, and another month's upon the other screw; then, if the solid disks are screwed to the ends of the screws projecting from the screw-holes, the brass cylinders can be broken off, and the volume for two months is completely bound; a stout piece of muslin should now be glued to the backs, and a finish given to the binding by gluing upon this a strip of red leather, labelled distinctly with the first and the last number of the prescriptions bound in the book. If a shelf is appropriated to these prescription-books, they may be made to appear like regularly bound library-books. The original prescriptions are thus bound permanently without altering or defacing them.

FIG. 378.



Huncke's prescription-case.

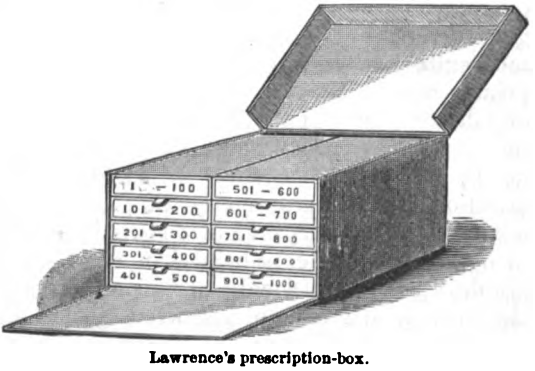
FIG. 379.



Huncke's prescription-box.

Many pharmacists copy their prescriptions into a book kept for the purpose. This plan is not always a judicious one: the chances of making errors are increased, and, in case of dispute, proof of the correctness of the copy would have to be produced.

FIG. 380.

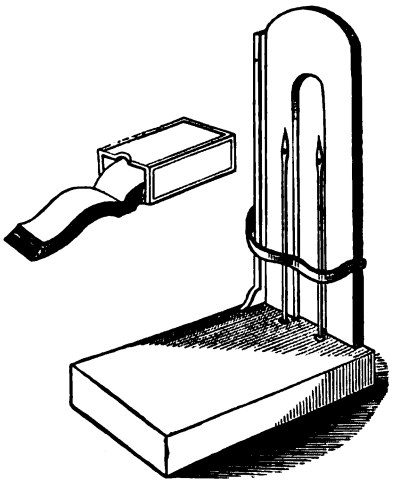


Lawrence's prescription-box.

A Prescription-Depository, devised by E. W. Huncke (see Fig. 378), consists of a number of flexible envelopes, in which the prescrip-

tions are placed consecutively: these are marked and numbered upon the edge, and kept in a box which is labelled, so that the contents may be known at a glance (see Fig. 379). A similar prescription-box is made by J. F. Lawrence, of Chicago (see Fig. 380).

FIG. 381.



Naulty's prescription-file.

Naulty's Prescription-File is shown in Fig. 381. The prescriptions are held securely upon two needles in such a position that for reference they can be found quickly and an unobstructed view obtained whilst compounding, the band shown in the cut being used for holding the succeeding prescriptions up. When a month's prescriptions, or any desirable number, have been filed, the needles are threaded with strong twine, and the pile pulled carefully off, the twine passing through the holes; the ends of the twine are now secured and a piece of thick muslin glued upon the back, and the back dated and numbered: the books are then placed in boxes, which are likewise numbered and dated distinctly. The cut also illustrates the method of keeping the bound book open whilst compounding a prescription.

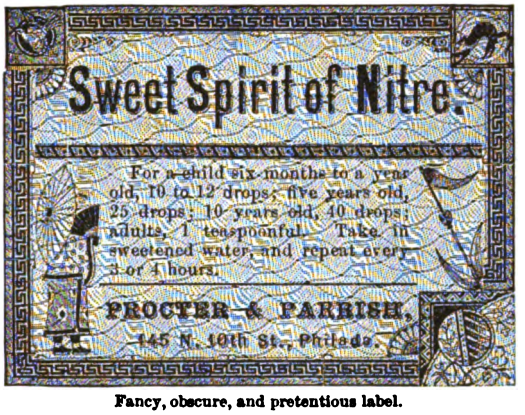
LABELS.

It should be an invariable rule, in dispensing, that *every medicinal substance* sent out from the store *must have* a neat and distinct label upon it. It is necessary to establish this rule as a fixed custom or habit, for neglect of this precaution will often result in serious consequences. In addition, every package *should be labelled at once*, particularly in the case of prescriptions: the habit of permitting unlabelled packages to remain about, liable to substitution, will inevitably cause doubt, and give rise to some grave mistake, sooner or later. A very great diversity of opinion and taste is apt to prevail with regard to the most suitable style of label to select for general use: formerly the home printer was exclusively depended upon, but the principle of division of labor has led to the establishment of "druggists' printing-houses" in several sections of the country; this has resulted in cheapening labels, and the labor seems to have been largely expended in this direction, and towards elaborating gaudy designs, very few attempts having been made as yet towards attaining that simplicity and elegance in design which the principles of good taste clearly dictate. Lithographed labels are sought for principally because the designs more closely approach those of engraved labels; but engraved labels cannot be used generally, because of their costliness.

Bronze-, green-, and red-bordered labels are seen in label catalogues

in great profusion, and in one a sentimental moonlight Venetian scene in colors is conspicuously displayed on one end of a castor oil label! One leading principle will probably be of service in this connection, and that is to avoid loud, striking designs of all kinds: the appetite of

FIG. 382.


Sweet Spirit of Nitre.
For a child six months to a year old, 10 to 12 drops; five years old, 25 drops; 10 years old, 40 drops; adults, 1 teaspoonful. Take in sweetened water, and repeat every 3 or 4 hours.
PROCTER & PARRISH,
145 N. 10th St., Philada.

Fancy, obscure, and pretentious label.

all, patient, pharmacist, and physician, soon becomes satiated with such, and the notion that they influence business in any good way is soon proved to be a delusion. The almost universal tendency of printers in selecting type for a label is to choose the largest that can possibly be used to get the subject-matter inside the border: the effect is exactly

FIG. 383.

SWEET SPIRIT OF NITRE.

For a child six months to a year old . .	10 to 12 drops.
Five years old	25 drops.
Ten years old	40 drops.
Adults	1 teaspoonful.

Take in sweetened water, and repeat every 3 or 4 hours.

PROCTER & PARRISH,

145 N. TENTH STREET, PHILADELPHIA.

Plain, old-fashioned, and inexpensive label.

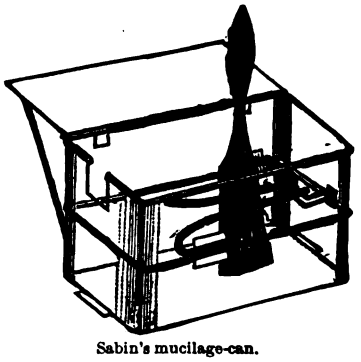
opposite to that which is usually desired, for it adds nothing to the neatness of the label, certainly sacrifices distinctness, and the general impression conveyed is that of a confused mass of letters, which is more difficult to decipher than letters of the proper size and breadth of face appropriately set off by *sufficient blank space*. Plain black letters on a white ground are preferable. (See Figs. 382 and 383.)

Neatness, distinctness, and simplicity are cardinal principles in de-

signing labels, and the reputation of many establishments is frequently judged from the character of the outward signs of neatness and care. For this reason particular attention should be paid to prescription labels, not only to have the printed address plain, clear, and neat, but to have the handwriting to correspond. In these important particulars patients are exceedingly apt to form an estimate of the qualifications of the compounder of a prescription from the style of his penmanship, reasoning that if he is careful, clean, and neat in the *one particular* of which they are competent to judge,—*i.e.*, the handwriting on the label,—the compounder must exercise similar qualifications in the more vital operations involved in compounding and dispensing, for upon the technicalities of the latter they cannot hope to pass judgment.

Labelling Poisonous Substances.—Whenever a poison is dispensed to customers upon an order, without being prescribed by a physician, the word poison should be distinctly written upon the label: if solid, and wrapped in paper, it should have two wrappers upon it, and both should be labelled poison. In the case of prescriptions, the word poison *should not appear upon the package or bottle unless the physician has so directed.* A careful pharmacist will be sorely tempted to prevent possible accident by pasting a poison label upon the package, but he is relieved entirely of responsibility if the dose is not excessive and if the physician has not directed it, because there is usually a special reason *for omitting it* from the label,—namely, that of avoiding the possibility of frightening the patient and thus defeating the object of the prescription. When a poison label is to be used upon a bottle it should be pasted on above the prescription label, so that it will be more likely to be seen, without possibility of failure through being covered by the hand holding the bottle.

FIG. 384.



Sabin's mucilage-can.

Pasting Labels.—Few of the minor operations in dispensing are more important than this. Although frequently the subject of remark and criticism, there have been comparatively few real improvements in this direction. Sabin's mucilage-can is a convenience which many appreciate, particularly the advantages of the simple device for avoiding an excess of paste on the brush. The label is laid upon the back of the lid of the can, which is thrown back for the purpose, and held in position. The can should be closed when not in use. (See Fig. 384.) The best paste for prescription use is made from flour by the following process:

FLOUR PASTE.

Flour (wheat)	4 oz. (troy).
Water	16 fl. oz.
Nitric Acid	1 fl. dr.
Oil of Cloves	5 minims.
Boric Acid	10 grains.

Thoroughly mix the flour, boric acid, and water, and strain the mixture through a sieve; add the nitric acid; apply heat, with constant stirring, until the mixture has thickened; when nearly cold, add the oil; strain it through coarse muslin if not perfectly smooth. This paste keeps well, and is much superior to tragacanth mucilage and ordinary paste. When it is required for pasting labels on tinned surfaces, the addition of 10 per cent. of glycerin will prevent the labels from falling off after drying.

In applying a label which has been pasted to a box, bottle, or can, care should be used not to touch with the fingers the portion of the label which has been recently written upon, even if it has the appearance of being dry. A piece of blotting-pad or filtering-paper, slightly larger than the label, should be laid upon it, and pressed gently, smoothly, and evenly, so that the excess of paste which has exuded upon the edges may be absorbed. If a label has had too much paste applied, and the excess has not been pressed out as described, it will have a wrinkled appearance. Labels should be neatly trimmed, showing a very slight but uniform margin around the border. They should be pasted upon bottles just above the centre, and never over the seams or mould-marks, but halfway between them.

FIG. 385.

Label-dampener.

Gummed Labels, or labels printed on paper coated with a solution of dextrin, or gum, on one side, are used largely in some sections of the country. They appear to answer a good purpose in some localities where there is a dry atmosphere, but when used on the seaboard or in damp atmospheres considerable loss is often experienced from their sticking together. Fig. 385 shows a label-dampener which was obtained from the Pictorial Printing Company of Chicago. It is a brass cylinder, having a tightly-fitting screw-cap, with a slightly perforated bottom covered with felt. The cylinder is filled with water, sufficient of which oozes through the perforation to keep the felt moist.

Arranging and Preserving Labels.—A method of classifying labels must be adopted by each pharmacist which will be suited to his own requirements. The general rule is to arrange them in label drawers in the most convenient place in the store. The label drawers are preferably shallow, made of wood, and having compartments to receive the labels. Considerable space may be saved by having the compartments made of tinned iron instead of wood. The bottom of the drawer may be lined with cotton-flannel, to prevent the labels from slipping underneath the tin divisions and becoming mixed by the continuous opening and closing of the drawer. It will be found convenient to separate the plain labels required constantly for articles in daily request from those of larger size or special design; and the former may be classified into labels for solids and labels for liquids. These may be arranged alphabetically in each drawer, so that they shall be quickly found. *A regular system should be adopted and rigidly carried out; and when a place has been once fixed for a label, it should never be changed*, as few trifles give more annoyance than inability to find a label in a pressing rush of business.

The upright label cabinets which have been contrived answer an excellent purpose where upright space can be spared.

CHAPTER LXV.

EXTEMPORANEOUS LIQUID PREPARATIONS.

Solutions, Mixtures, and Emulsions.

OFFICINAL liquid preparations have been treated of in Part II. They will therefore not be considered in the present chapter, which will be confined to the extemporaneous compounding of liquids. It will soon be realized by the student that this branch of practical pharmacy involves some of the most intricate questions of physical and chemical science: the knowledge which he has heretofore acquired of the solubilities of solids in various solvents, simple and compound, the solubility of liquids with one another, chemical decompositions, reactions between acid and alkaline salts, precipitation through single and double decomposition, etc., will often be of great service. This, coupled with practical experience, together with the exercise of original ingenuity, must be depended upon to meet the perplexing questions which continually arise.

Extemporaneous liquid preparations may be classified as follows: 1. *Solutions*, by which are meant liquid preparations containing dissolved solid substances. 2. *Mixtures*, liquids in which the solution is but partial, insoluble particles being held in suspension. 3. *Emulsions*, preparations containing oily or resinous substances mixed with water so as to form homogeneous liquids. These will be considered *seriatim*.

1. **Solutions.**—The methods generally employed in making solutions have been treated of in the preceding chapters, and it must be presumed that the reader is familiar with them. Most of the difficulties encountered in effecting solutions required by prescriptions arise from the want of knowledge on the part of prescribers of the solubilities and of the physical and chemical characteristics of the medicinal agents which they order to be compounded. It is necessary, therefore, for the pharmacist to be well grounded in these particulars, whilst therapeutical knowledge must not be neglected either, lest the addition of some apparently inert substance, intended to improve the preparation pharmaceutically, be injurious therapeutically. The subject of incompatibility must be thoroughly comprehended.

INCOMPATIBILITY.

Incompatibility may be defined as the condition produced by bringing substances together which results in chemical decomposition, pharmaceutical dissociation, or therapeutical opposition. There are, therefore,

three kinds of incompatibility,—Chemical, Pharmaceutical, and Therapeutical.

Chemical Incompatibility invariably results in the decomposition of one or more of the ingredients entering into the prescription: it must not be assumed, however, that this decomposition is always unintentional on the part of the prescriber. The most frequently occurring forms of chemical incompatibility are indicated as follows:

1. Through the precipitation of an insoluble salt, produced by the addition of one solution or salt to another.
2. By the decomposition of a salt (in solution) containing a base united with a weak or volatile acid, by the addition of a strong acid.
3. Through the decomposition of a salt (in solution) containing an acid united with a weak or volatile base by the addition of a strong alkali.
4. By the precipitation of alkaloidal salts by the addition to their solutions of alkalies, alkaline salts, or salts which produce insoluble compounds.
5. By the unsightly discoloration or precipitation due to the formation of inky compounds, produced by bringing astringent solutions containing tannin or similar substances in contact with ferric salts.
6. By the decomposition of a solid substance without precipitation, because of the formation of products which are soluble in the liquid.

1. *Through the precipitation of an insoluble salt, produced by the addition of one solution or salt to another.*

Incompatibility in this case may be either Intentional or Unintentional.

Chemical incompatibility is a condition which is very likely to be misunderstood. It does not follow that because precipitation ensues when two transparent liquids are mixed, or in any other way, the decomposition was not intended. Cases of this kind demand good judgment on the part of the pharmacist: this may probably be best illustrated by the following examples:

℞ Plumbi Acetat., ℥ss;
Zinci Sulphat., gr. xv;
Aq. Rosæ, f℥iv. M.
Sig.—Use as an injection.

The novice would be very apt to imagine that the doctor had made a mistake in writing this, or was sadly deficient in chemical knowledge not to be aware that decomposition would take place here, that the insoluble lead sulphate would be formed, and that the astringency of the salts would be destroyed; but the experienced pharmacist would know at once that he must not filter this prescription, but dispense it with a "shake" label, because the precipitated lead sulphate is the really important agent. A very different case is presented in the following, which may be cited as an illustration of chemical incompatibility arising from lack of knowledge of the solubilities of the salts on the part of the prescriber:

℞ Quininæ Sulph., gr. x;
Potassii Acet., gr. xx;
Acid. Sulph. Dil., gtt. v;
Aquæ Cinnamomi, f℥i.
Sig.—A tablespoonful every three hours.

The usual procedure would be either to dissolve the quinine salt in the cinnamon water with the aid of the diluted sulphuric acid, and then add the potassium acetate, or to make separate solutions of each, and then mix them. In either case the result would be the formation of a voluminous precipitate of quinine acetate, preventing the possibility of carrying out the directions to the patient of taking a tablespoonful, because it could not be poured. Although this precipitate could be dissolved in acetic acid or alcohol, so much would be required of either that the character of the prescription would be materially altered: hence sulphate of quinine and acetate of potassium should never be prescribed together in solution. Many other illustrations of chemical incompatibility could be given, but want of space will prevent giving more than one example of each class.

2. *By the decomposition of a salt (in solution) containing a base united with a weak or volatile acid, by the addition of a strong acid.*

It would appear at first sight that cases in which this condition is present must be rare: the intentional decomposition of an alkaline carbonate by citric, tartaric, or acetic acid is very common, however, and most agreeable and successful febrifuge solutions are made in this way. Unlooked-for decomposition most frequently arises from the use of the vinegars or syrups containing acetic acid in the same prescription with alkaline carbonates, the presence of the acid being generally lost sight of by the prescriber. The following is a good example:

℞ Ammon. Carb., gr. xx;
Ammon. Chlor., gr. xxx;
Syr. Allii, f℥i;
Aquæ, q. s. ft. f℥ij.
Sig.—A half-teaspoonful as required.

Explosions have occurred in compounding this prescription, when the syrup of garlic has been placed in the bottle and the solutions of the ammonium salts added, and the cork inserted securely. The only way to compound it safely would be to mix the solution of the ammonium salts with the syrup of garlic in a mortar, and to allow all the carbonic acid gas, produced by the action of the acetic acid in the syrup on the ammonium carbonate, to escape, assisting the evolution by stirring with the pestle.

3. *Through the decomposition of a salt (in solution) containing an acid united with a weak or volatile base by the addition of a strong alkali.*

Instances are less frequent where this condition exists, although it is sometimes seen; as when ammonia-alum is directed to be mixed with potassium hydrate to form an astringent caustic, gaseous ammonia being liberated through decomposition.

4. *By the precipitation of alkaloidal salts by the addition to their solutions of alkalies, alkaline salts, or salts which produce insoluble compounds.*

This form of incompatibility is one of the most dangerous that are likely to be encountered. The alkaloids are very largely used, and are nearly all violent poisons; they are usually combined with acids in order to present them in forms which are soluble: sulphate of strychnine, for instance, is soluble in about 10 parts of water, whilst strychnine requires 6700 parts of water to dissolve it; the combination of an alkali

or an alkaline salt with the sulphate of strychnine would throw the strychnine out of solution.

℞ Strychninæ Sulph., gr. i;
Potassii Bromid., ʒvij;
Aquæ, q. s. ft. fʒviij.

An inexperienced pharmacist would unhesitatingly proceed to compound the above prescription. A transparent solution would be obtained without difficulty, which would be dispensed without the slightest misgiving, but which in all probability would produce disastrous results. This solution deposits in a few hours the greater part of the strychnine salt as an insoluble bromide, which quickly subsides in transparent crystals. A lady in England lost her life by taking a similar mixture. She carefully refrained from shaking the bottle, the strychnine precipitate formed in the bottom, and in taking the last dose she swallowed nearly all of it. A similar case of dangerous chemical incompatibility occurred in the author's personal experience, the following having been prescribed by a physician who had overlooked the fact that the salts of most alkaloids are decomposed by alkaline solutions, and the alkaloids, being less soluble than the salts, are precipitated:

℞ Morph. Sulph., gr. ij;
Potass. Bicarb., gr. xc;
Aquæ, q. s. ft. fʒij.
Sig.—Take a teaspoonful mixed with half a teaspoonful of lemon-juice.

The morphine was precipitated by the alkaline carbonate; and if the bottle had not been shaken before pouring out the teaspoonful which was mixed with the lemon-juice, the last dose would have contained nearly all of the morphine.

5. *By the unsightly discoloration or precipitation due to the formation of inky compounds, produced by bringing astringent solutions containing tannin or similar substances in contact with ferric salts.*

The frequent occurrence of incompatibility of this kind is accounted for by the extensive employment of liquids containing tannin with iron salts. Preparations of cinchona bark with iron are probably the best illustrations of this class:

℞ Ferri Sulph., gr. xx;
Tinct. Cinch. Comp., fʒij.
Sig.—A teaspoonful before meals.

6. *By the decomposition of a solid substance without precipitation, because of the formation of products which are soluble in the liquid.*

Prescriptions containing syrup of lactucarium and alkaline solutions often lose their sedative effect through the action of the alkali. Syrup of chloral when mixed with alkalies is injured through the elimination and subsequent evaporation of chloroform. The importance of a knowledge of the physical properties of chemical substances is realized very frequently in cases of this class.

Pharmaceutical Incompatibility may be defined as the condition arising from the admixture of pharmaceutical preparations which results

in the *physical* dissociation of one or more constituents. It differs from chemical incompatibility by the absence of *chemical* action, and is generally produced by adding one liquid or substance to another, which results in the precipitation of solid matter or the separation of a portion of liquid: hence the solubilities of substances in liquids and the relative solubilities of various liquids with one another determine to a very great extent the condition of pharmaceutical incompatibility. The illustrations of this condition are so numerous that it would be idle to select more than a few which are prominent or typical. Two classes may be distinguished: 1, Pharmaceutical incompatibility resulting in the separation of *active or important* constituents, and, 2, Pharmaceutical incompatibility resulting in the separation of *inert* constituents.

1. *Pharmaceutical incompatibility resulting in the separation of active or important constituents.*

This condition is one which usually demands skilful treatment. It is seen most frequently in the precipitation produced by mixing resinous tinctures or oily liquids with aqueous liquids, or alcoholic solutions containing volatile oils, chloroform, ether, or similar substances with aqueous liquids, or by the addition of acids to solutions containing quinine with a preparation of liquorice. The addition of acacia, so as to form an emulsion with the resinous tincture and the aqueous liquid, is necessary in the first case, and will be considered under the head of emulsions. Aqueous liquids mixed with alcoholic solutions containing volatile oils can usually be made transparent by filtering them through an absorbent powder like magnesium carbonate, as in the case of the medicated waters or elixirs. A frequent source of doubt arises in the case of prescriptions like the following:

For Willie.

℞ Quininæ Sulph., gr. xxx;
Acid. Sulph. Dil., q. s.;
Ext. Glycyrrh. Fld., ʒij;
Syrupi, ʒiv.
Sig.—Give a teaspoonful three times a day.

The indications are clear that this is a quinine mixture intended for a child, and that the prescriber has directed the fluid extract of liquorice with the view of making it more palatable. The habit of ordering acid in connection with quinine clings to him still, and in all probability he is not aware of the fact that the sweet principle of liquorice, glycyrrhizin, is precipitated by the acid, so that the object of using the preparation of liquorice is entirely defeated by the addition of the acid. Solutions of quinine should be administered either as transparent liquids when the presence of acid is relied upon to effect the solution, or as mixtures with syrups or with thick liquids containing liquorice; in the latter case the object is to *prevent* solution as much as possible, and frequently a trace of solution of potassa is added with this end in view, —the principle being, that the smaller the quantity of *dissolved* quinine present in the liquid the less bitter will be the taste. The mixture should be thoroughly shaken before administration.

2. *Pharmaceutical incompatibility resulting in the separation of inert constituents.*

This condition is most frequently seen when fluid extracts are diluted with liquids which differ in composition from those used in making the fluid extract, such as alcohol, diluted alcohol, syrup, aqueous liquids, etc.: the gummy, albuminous, resinous, or mucilaginous constituents are often thrown out of solution. After proving that the precipitate is inert, the remedy is simple in such cases, and filtration is all that is necessary.

Therapeutical Incompatibility may be defined as the condition arising from the combination of remedies which are mutually opposed to one another in therapeutical effect. This form of incompatibility does not require the aid of the pharmacist: it results from an injudicious combination of remedial agents, and the correction of the fault lies solely within the province of the physician.

COMPOUNDING EXTEMPORANEOUS SOLUTIONS.

Use of Heat.—As a general rule, it is not advantageous to aid the solution of a solid by heating it in contact with the solvent, except where the quantity of liquid is known to be in excess of what is required to form a solution; and such a liquid should never be dispensed until it has become cool. If the solid be crystalline, the excess will surely separate in crystals when the liquid cools, and the patient will become uneasy and suspicious, fearing lest some mistake has occurred. It frequently happens that more of a solid has been prescribed than can be dissolved in the amount of liquid desired; indeed, it is entirely too much to expect that every practitioner should carry in his mind the exact solubilities of all the solids that he prescribes in the respective liquids in which he may wish to dissolve them. This gives the pharmacist another opportunity to use his knowledge and judgment, and the problem

When to Filter is oftentimes perplexing, although one simple rule should govern the practice: *A solution may be filtered and dispensed as a transparent liquid when the removal of the excess does not interfere with the medicinal properties and action of the medicine, nor conflict with the obvious intention of the prescriber.*

Solutions of potassium chlorate, to be used as gargles, are good illustrations:

℞ Potassii Chlorat., ʒiv;
Aquæ Acidi Carbolici, fʒij;
Infus. Salviæ, fʒiv.
Sig.—Use as a gargle.

The quantity of the salt here is about twice too much, and, as the solution is intended as a gargle to inflamed surfaces, the undissolved particles of chlorate of potassium would probably act as irritants. They can be of no use in the solution, and in this case filtration is perfectly admissible. The following prescription should not be filtered, and the pharmacist is compelled to rely solely upon his judgment and knowledge of the therapeutical action and properties of the ingredients:

℞ Magnesiæ Pond., ʒiss;
Massæ Hydrarg., ʒss;
Sacch. Alb., ʒi;
Spt. Ammon. Arom., ʒij;
Aq. Menth. Pip., fʒij;
Aq. Calcis, fʒiij.
Sig.—A tablespoonful every two hours.

The reasoning here would be direct and simple. The prescriber evidently intends this to be an alkaline cholagogue mixture, although the directions to "shake the bottle" have been omitted. Heavy magnesia and blue mass are both practically insoluble in the liquids, and if they are filtered or strained out the mixture is deprived of its most important constituents. It should be dispensed as a mixture, and a "shake" label used.

Aids in Effecting Solution.—The use of solvents which are not directed in the prescription, for the purpose of effecting the complete solution of the ingredients, requires probably the greatest amount of good judgment. The practice is one which is liable to great abuse, and a strict rule should be enforced that no addition is admissible under any circumstances except one which is absolutely demanded by necessity and which will in no wise impair the therapeutical effect. The prescriber should have reason to place implicit reliance upon the compounder and feel satisfied that he has received exactly what was ordered. The following is a good illustration of a case requiring an addition; a physician prescribed it as an application for dry, excoriated nipples:

℞ Acidi Carbolici, gr. xxx;
Aquæ, fʒss.
Sig.—Solution Carbolic Acid. Use with a camel's-hair brush.
Dr. W.

Of course carbolic acid is not soluble in water in the proportions named, only about 1 part dissolving in 20 parts of water. The pharmacist dispensed the prescription just as it was written, with the excess of carbolic acid in the bottom of the bottle. The patient inserted the camel's-hair brush and permitted it to remain in the bottle, so that it reached the bottom and became saturated with the undissolved carbolic acid. The application produced severe pain and alleged serious injury, and became the ground for a civil suit for damages against the pharmacist, brought by the patient. If the pharmacist had added a small quantity of glycerin, all difficulty would have been avoided, and he could then have dispensed a perfect solution. It is hardly necessary to say that the physician should not have omitted prescribing the glycerin; but, as he failed to do so, it was the duty of a careful pharmacist to inform him of the facts, or, failing to find him, to supply the deficiency and subsequently notify him of the addition.

The Order to be followed in Mixing the Ingredients is frequently very important, and many prescriptions which at first sight appear to contain incompatibles will be easily compounded by observing the proper order in mixing. As has been shown, precipitation frequently takes place when one liquid or solution is added to another, and this annoyance is much more apt to occur when concentrated solutions are

brought together: hence the dilution of the solution is recommended as one method of avoiding precipitation. An illustration is afforded in the following:

℞ Liq. Ammon. Acet., f℥iv;
Acidi Acetici, f℥i;
Tinct. Ferri Chloridi, f℥ss;
Glycerini, f℥ss;
Mucilaginis Acaciæ, ad f℥viij.
Sig.—A teaspoonful every three hours.

If the tincture of chloride of iron be mixed with the acetic acid and glycerin, and then added to the solution of acetate of ammonium, and this solution mixed with the mucilage of acacia, no gelatinization will occur; but if the tincture of chloride of iron be added to the mucilage, undiluted, a gelatinous precipitate will form, and although the subsequent addition of the other ingredients will, in time, dissolve the precipitate, this time could be saved by following the proper order. Then, again, in the following:

℞ Hydrarg. Chlor. Corros., gr. ij;
Mucilag. Acaciæ, f℥i;
Aquæ,
Aquæ Calcis, ää f℥ij.

If the corrosive chloride of mercury be dissolved in the water and then mixed with the mucilage, and the lime-water added subsequently, no precipitation will occur; but if the corrosive chloride of mercury be added to the lime-water, and then to the other ingredients, the yellowish-red mercuric oxide will be formed, which is insoluble in the liquid.

The following rule should be insisted upon: *Whenever a difference in the appearance of a liquid is produced by a variation in the order of mixing, a memorandum noting the order should be made upon the prescription at the time it is compounded, so that in case of renewal the same order may be followed.*

MIXTURES.

Mixtures, properly speaking, are aqueous preparations intended for internal administration, containing some insoluble substances, with frequently viscid or sweet liquids to aid in suspending them. The officinal mixtures have been already noticed (see page 271). The term mixture, however, is indiscriminately applied in extemporaneous pharmacy and in prescriptions to aqueous solutions of all kinds: for instance, solution of citrate of potassium is frequently termed fever mixture, although it is a perfectly transparent solution.

Most of the remarks made upon solutions will be found to apply to the preparation of mixtures. Especial care must be taken to obtain the precipitate in as light a form as possible, so as to avoid impaction and partial solidification in the bottle: this may be best done by avoiding the mixing of concentrated solutions.

EMULSIONS.

Emulsions are aqueous liquid preparations in which oily or resinous liquids are suspended by the agency of gummy or viscid substances. They may be conveniently divided into two classes: 1. Natural emul-

sions. 2. Manufactured emulsions. They are opaque liquids, generally of a thick consistence.

1. **Natural Emulsions** are those which are found in nature, ready formed, as the milky juices of plants, the milk of animals, yolk of egg, etc.

2. **Manufactured Emulsions** are those which are made artificially by various processes: the art of producing them is termed *emulsification.*

Manufactured emulsions are usually made from two classes of substances: 1. Those which contain an oily or a resinous compound associated *naturally* with either gum or some other emulsifying agent. 2. Oils, fatty and resinous bodies containing no emulsifying substance.

Gum-resin emulsions and seed emulsions are included in the first class. These are usually made by simple trituration in contact with water.

Gum-resin emulsions are made by reducing to a coarse powder, selected pieces of the gum-resin in a mortar, triturating with a small quantity of water so as to form a smooth, uniform paste, and then adding the remainder of the water, finally straining the mixture through a cloth strainer or a plug of absorbent cotton contained in a funnel. (See Mistura Asafœtidæ, page 272.) Powdered gum-resins should never be used for making emulsions, because of the loss or deterioration of the volatile constituents which always takes place when the substance is dried so that it may be powdered.

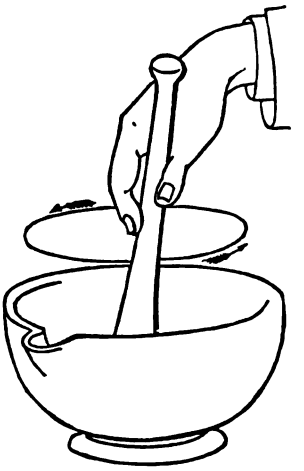
Seed emulsions are so termed because they are made by rubbing seeds or the kernels of fruits which contain fixed oils with water, the emulsifying agent being a gummy or albuminous substance found naturally in the seed or kernel associated with the oil. Emulsions of almond, castor-oil bean, croton-oil bean, etc., are examples of this kind. (See Mistura Amygdalæ, page 272.)

The Theory of Emulsification is based upon a study of the best type of a natural emulsion,—namely, milk. This liquid is found, on examination, to consist of innumerable globules of a fatty substance (butter) enveloped in a thin membrane of viscid matter (casein) suspended in water. The object sought by the pharmacist in making emulsions is first to thoroughly divide the oily or resinous liquid into minute globules, and then to surround each globule with an adhesive envelope (mucilage of acacia, yolk of egg, etc.). The globules, when completely enveloped, are suspended in water; and if the emulsion is properly made, there will be no tendency on the part of the oily or resinous liquid to recombine. Several methods are employed in making emulsions, the most important of which, however, may be grouped under *two* typical methods, named from the geographical locations where they are used most frequently: 1. The English method. 2. The Continental method. Both are equally useful, and should be employed according to circumstances.

1. **The English Method.**—In this mode of making emulsions the emulsifying agent, consisting of mucilage, yolk of egg, etc., is first placed in a dry mortar, and small quantities of the oil and water are gradually and alternately added at intervals. The pestle is rapidly and

lightly rotated in the direction of the arrows (see Fig. 386), with the effect of dashing the oil into globules, which are at once enveloped by the viscid emulsifying agent. If the oil or water is added too rapidly at the beginning, or the mucilage has not been thick enough, the accident of "*cracking*" the emulsion occurs. This may be known by the "pearly" appearance assumed by the mixture, and on close examination the globules of unenveloped oil may be seen floating about. If each stage of the process is successful, the emulsion presents, upon thorough mixing after each addition, a smooth, opaque, glistening appearance like cream. Success depends largely upon the care exercised in forming the nucleus at the beginning; and this, therefore, should not be too hastily made. When an emulsion is "cracked," it need not be thrown away. It may be restored by placing an additional quantity of mucilage in the mortar and gradually adding the "cracked" emulsion to it, triturating after each addition, when finally the satisfaction of seeing the uncombined globules disappear will generally be experienced.

FIG. 386.



Emulsion mortar and pestle.

The English method of making emulsions is the best to use in general prescription practice, where the proportions of gum, oily, or resinous liquids and water must necessarily vary. A typical formula is appended:

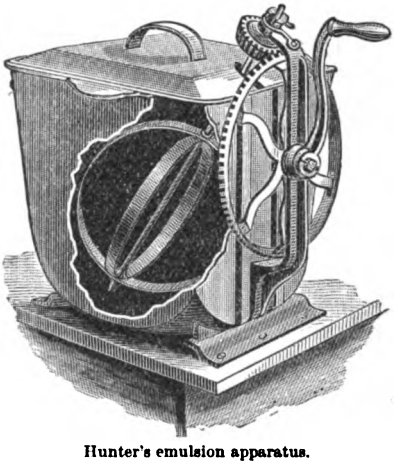
℞ Olei Morrhuæ, f℥ij;
Pulv. Acaciæ, ℥ss;
Aquæ, q. s. ft. f℥iv.

Place the acacia, which should not be finely powdered, but granulated, in a mortar with one fluidounce of water: this should be triturated until the mucilage is perfectly smooth and free from lumps. The oil should be added at first in quantities not greater than half a fluidrachm at a time, stirring rapidly with the pestle after each application, care being taken not to add a fresh portion of oil until the last has been thoroughly emulsified. When the liquid becomes too thick to be easily stirred, a fluidrachm of water should be mixed with it, and the gradual additions of oil continued until the whole quantity has been used: the larger quantity of water may be added rapidly after the nucleus is once properly formed, without risk.

2. **The Continental Method** has the great merit of never failing to produce a good emulsion if the proper proportions are used to form the nucleus, and if the directions are strictly followed. The most satisfactory proportions for the nucleus may be easily remembered: half as much water is taken as of oil, and half as much gum as of water; or it may be expressed as oil, 4; water, 2; gum, 1. The four parts of oil must be placed in a dry mortar and one part of finely-

powdered gum added to it, stirring with the pestle; when a uniform mixture is made, two parts of water are added, not gradually, but all at once, when, upon stirring, the emulsion is quickly made: an additional quantity of water may be added to this nucleus without risk. The explanation of making an emulsion by this method is, that the particles of gum, being insoluble in the oil and surrounded by it, are prevented from separating and dissolving in the water so as to form lumps; by stirring the mixture actively the water *gradually* dissolves the gum, the oil becomes incorporated at the same time, and a homogeneous mixture is produced, the quantities of oil, gum, and water being in exactly the right proportions to form an emulsion.

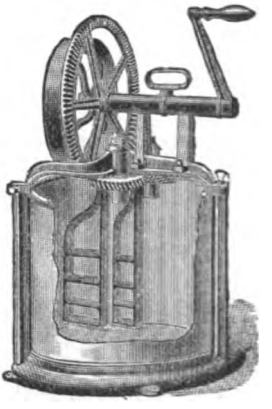
FIG. 387.



Hunter's emulsion apparatus.

In making large quantities of emulsions some mechanical device must be used to facilitate the rapid stirring and agitation necessary to form the nucleus. Fig. 387 represents Hunter's emulsion apparatus, or egg-beater. The principle of action is so well shown here that a description is unnecessary. If emulsions are to be made in still larger quantities, the sifter and mixer shown in Fig. 202 can be used by taking out the sieves and lining the receiving-box with tinned copper or otherwise making it water-proof, thus using only the mixer.

FIG. 388.



Sparrow mixer.

The Sparrow mixer is shown in Fig. 388: in this ingenious apparatus two stirrers are made to revolve by turning the gear-wheel, and a very rapid and effective motion may be imparted.

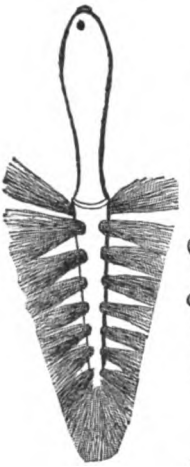
Compound Emulsions.—As a general rule, the addition of alcoholic liquids to emulsions destroys their homogeneity: when it is necessary to add them in compounding prescriptions, they should be diluted, if possible, with a portion of the water, and added after the emulsion is nearly finished. Alkaline solutions generally aid emulsification, by forming soaps with the resinous or oily liquids; volatile oils make more stable emulsions if they are first mixed with an equal volume of fixed oil.

THE DISPENSING OF LIQUIDS.

Every convenience should be adopted to facilitate quick and accurate dispensing. The sink should be close to the prescription counter. A good draining surface for graduates to rest upon is made by fastening

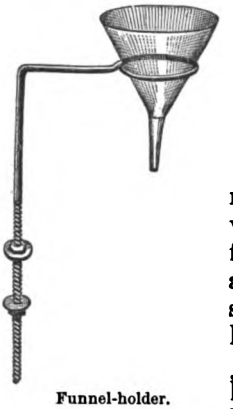
sheets of corrugated rubber (a piece of rubber matting) to the slightly-inclined shelves above the sink (see Fig. 117); and a brush for quickly cleaning graduates should be accessible (see Fig. 389). In addition to the

FIG. 389.



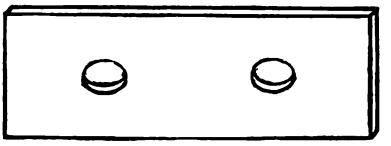
Graduate-brush.

FIG. 390.



Funnel-holder.

FIG. 391.



Funnel-board.

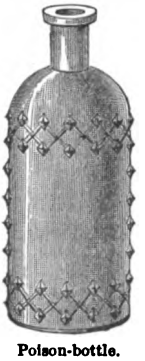
retort-stand already referred to, the very convenient little funnel-support figured in New Remedies a few years ago may find a place upon the prescription counter (see Fig. 390): the long screw permits the ring to be adjusted to any desired height. For larger filtering operations the funnel-board (Fig. 391) will prove useful.

Bottles.—The size and shape of the bottles used in dispensing liquids are largely matters of individual taste. The tendency at present is towards oval bottles for prescriptions, because they afford proportionally more space for the label than either round or square bottles: this is noticeable to a greater extent in the smaller sizes than in the larger ones. In addition to this, oval bottles are more convenient to carry in the pocket than those of any other shape. Fig. 392 shows an oval metric bottle.

FIG. 392.

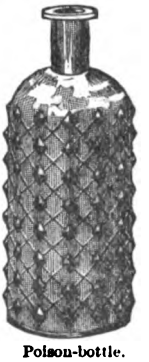
Oval metric bottle.

FIG. 393.



Poison-bottle.

FIG. 394.

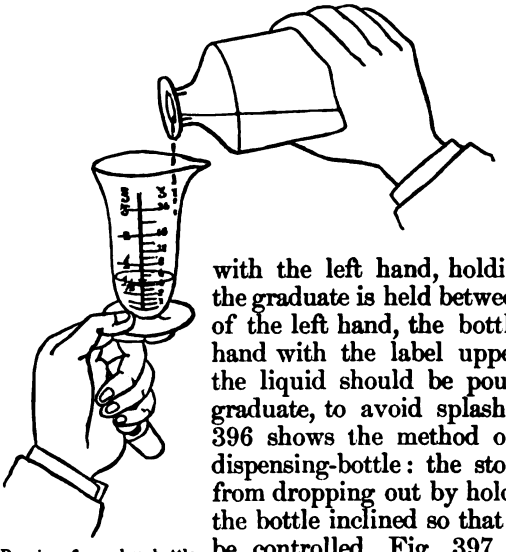


Poison-bottle.

Prescription-bottles are now frequently made of amber glass, to protect the contents from the effects of the actinic rays of light. For poisonous liquids, or for liquids intended for external application, blue bottles studded at regular intervals with pyramidal points are used: these are

designed to attract attention through their peculiar color and shape, and thus prevent errors; the points render them easily distinguishable from ordinary bottles by the sense of touch, so that the patient can recognize a poisonous liquid in the dark. Fig. 393 and Fig. 394 show two sides of this bottle.

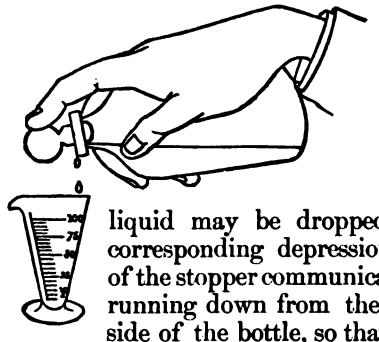
Fig. 395.



Pouring from shop-bottle.

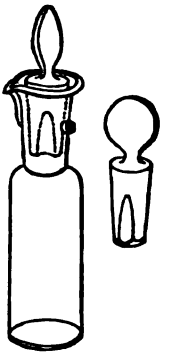
In pouring liquids from the dispensing-bottles it is well to establish the habit of extracting the stopper with the left hand, holding it with the little finger; the graduate is held between the forefinger and thumb of the left hand, the bottle is grasped by the right hand with the label uppermost (see page 898), and the liquid should be poured down the side of the graduate, to avoid splashing (see Fig. 395). Fig. 396 shows the method of dropping liquids from a dispensing-bottle: the stopper is loosened, prevented from dropping out by holding it with the finger, and the bottle inclined so that the rate of dropping may be controlled. Fig. 397 shows a very convenient bottle for dispensing liquids which are to be administered by drops: it is made in Germany. The glass stopper has a deep conical depression extending nearly half-way up the side, whilst the neck of the bottle is furnished with an aperture having a slightly projecting lip: when the stopper is turned so that the upper part of the depression is opposite the little aperture in the side, the liquid may be dropped very uniformly. A corresponding depression on the opposite side of the stopper communicates with a little channel running down from the lip upon the opposite side of the bottle, so that air is supplied during the dropping: by turning the stopper half-way around, both apertures in the neck of the bottle are closed.

Fig. 396.



Dropping from shop-bottle.

Fig. 397.



German dropping-bottle.

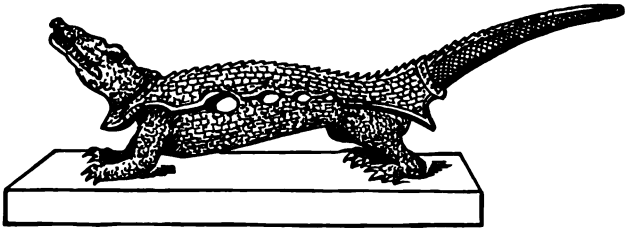
Corks are indispensable for stoppering bottles. They should be selected with great care. There is a wide difference in price between the best quality and the common grades, but it is true economy to use only the best. Short corks, which, when inserted tightly, so as to secure the contents from leakage, do not project above the lip sufficiently to furnish a good grasp for the fingers when extracting them, should never

be used for prescription-bottles. Brittle, hard, or dry corks, which break off when the attempt is made to remove them, are an especial annoyance. To avoid this, corks should not be kept in a warm, dry place, and before inserting them they should be well pressed. "Taper" corks are now invariably preferred to the "straight" form. Fig. 398 shows a modern form of cork-press which is largely used. The motion by which the pressure is effected is direct and simple. Pharmacists who incline to the grotesque in their tastes may prefer the kind shown in Fig. 399; but the practical dispenser will generally choose Lochman's cork-press (see Fig. 400), because the process of pressing the

FIG. 398.

Cork-press.

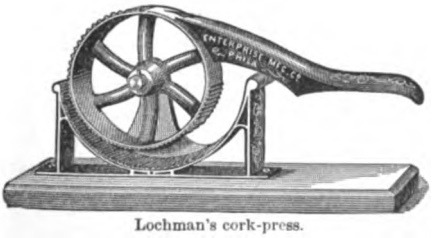
FIG. 399.



French cork-press.

cork is more effectual, and there is less likelihood of breaking it or cracking the surface in this press than in any other, for the cork is revolved whilst the pressure is gradually increased. The press consists of a cast-iron base, the upper portion of which is hemispherical, with the upper surface slightly corrugated; a corrugated cast-iron wheel is placed upon an axle slightly out of the centre of the curve of the base, so as to afford a gradually diminishing space between the curved surfaces. The wheel has a handle, which is raised when the tapered end of the cork is inserted between the surfaces; the handle is lowered, and the cork revolves whilst being pressed. A finish may be given to corks by the use of "gummed cork-tops." These are circular in form, made of paper, and the name of the pharmacist, or his monogram, is generally printed upon them in colors. These tops have largely supplanted the sealing-wax finish so much used a few years ago.

FIG. 400.

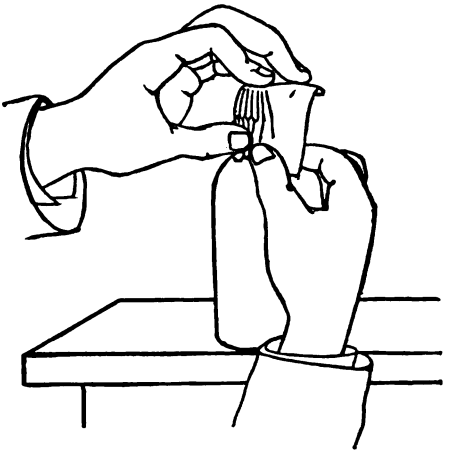


Lochman's cork-press.

Capping Bottles.—The practice of capping bottles with paper, kid, baudruche, or other material is a good one, principally because of the

feeling of security it gives to the patient that the contents of the bottle have not been tampered with after being dispensed. Hunt's bottle-caps are largely employed. These consist of fluted caps of colored paper, of various sizes, which are used by adjusting the proper-sized

FIG. 401.



Capping bottles.

cap to the corked bottle and tying it on. An equally neat effect may be secured, with a little practice, by capping a bottle with a piece of fancy paper, as shown in Figs. 401 and 402. The paper is held in the centre upon the cork by the forefinger of the left hand, whilst the

FIG. 402.

Capping bottles.

flutes are made by "plaiting" them in with the forefinger and thumb of the right hand: it is then secured by tying with twine, a knot with short ends being preferred, because it is less likely to be interfered with by a messenger, on account of the difficulty of retying it.

CHAPTER LXVI.

SOLID EXTEMPORANEOUS PREPARATIONS.

Powders, Cachets, Troches, Pills, and Suppositories.

Pulveres. *Powders.*

POWDERS often furnish a convenient and agreeable mode of administering medicines which are not bitter, nauseous, or otherwise offensive to the taste, are not corrosive, nor deliquescent, nor given in large doses. Pulverization facilitates the solution or the extraction of the soluble principles of a substance by extending the surface exposed to the action of the solvent. (See Comminution, page 146.) With the view of establishing a standard and encouraging uniform practice in prescribing certain forms of powders which have become well known, a limited number of compound powders have been admitted to the Pharmacopœia. They are as follows:

PULVIS ANTIMONIALIS. *U.S.* **Antimonial Powder.** [JAMES' POWDER.]

	Definite formula.
Oxide of Antimony, 33 parts, or	1 oz. av.
Precipitated Phosphate of Calcium, 67 parts, or	2 oz. av.
To make 100 parts, or	3 oz. av.

Mix them intimately.

PULVIS AROMATICUS. *U.S.* **Aromatic Powder.**

	Definite formula.
Cinnamon, in No. 60 powder, 35 parts, or	7 oz. av.
Ginger, in No. 60 powder, 35 parts, or	7 oz. av.
Cardamom, deprived of the capsules and crushed, 15 parts, or	3 oz. av.
Nutmeg, in No. 20 powder, 15 parts, or	3 oz. av.
To make 100 parts, or	20 oz. av.

Rub the Cardamom and Nutmeg with a portion of the Cinnamon, until reduced to a fine powder; then add the remainder of the Cinnamon and the Ginger, and rub them together until they are thoroughly mixed.

PULVIS CRETÆ COMPOSITUS. *U.S.* **Compound Chalk Powder.**

	Definite formula.
Prepared Chalk, 80 parts, or	1½ oz. av.
Acacia, in fine powder, 20 parts, or	1 oz. av.
Sugar, in fine powder, 50 parts, or	2½ oz. av.
To make 100 parts, or	5 oz. av.

Mix them intimately.

PULVIS EFFERVESCENS COMPOSITUS. *U. S.* **Compound Effervescing Powder.**

[PULVERES EFFERVESCENTES APERIENTES, Pharm. 1870. SEIDLITZ POWDERS.]

	Grains.	Grammes.
Bicarbonate of Sodium, in fine powder, *four hundred and eighty grains*	480	31.00
Tartrate of Potassium and Sodium, in fine powder, *fourteen hundred and forty grains*	1440	93.00
Tartaric Acid, in fine powder, *four hundred and twenty grains*	420	27.00

Mix the Bicarbonate of Sodium intimately with the Tartrate of Potassium and Sodium, divide the mixture into *twelve equal parts*, and wrap each part in a separate paper of some pronounced color, as blue.

Then divide the Tartaric Acid into the *same number of equal parts*, and wrap each part in a separate paper of a color distinctly different from that used for wrapping the mixture, as white. Keep the powders in well-closed vessels.

PULVIS GLYCYRRHIZÆ COMPOSITUS. *U. S.* **Compound Powder of Glycyrrhiza.**

	Definite formula.
Senna, in No. 60 powder, 18 parts, or	88 grains.
Glycyrrhiza, in No. 60 powder, 16 parts, or	76 grains.
Fennel, in No. 60 powder, 8 parts, or	38 grains.
Washed Sulphur, 8 parts, or	38 grains.
Sugar, in fine powder, 50 parts, or	240 grains.
To make 100 parts, or	480 grains.

Rub them together until they are thoroughly mixed.

PULVIS IPECACUANHÆ ET OPII. *U. S.* **Powder of Ipecac and Opium.**

[PULVIS IPECACUANHÆ COMPOSITUS, Pharm. 1870. DOVER'S POWDER.]

	Definite formula.
Ipecac, in No. 60 powder, 10 parts, or	60 grains.
Powdered Opium, 10 parts, or	60 grains.
Sugar of Milk, in No. 30 powder, 80 parts, or	480 grains.
To make 100 parts, or	600 grains.

Rub them together into a very fine powder.

PULVIS JALAPÆ COMPOSITUS. *U. S.* **Compound Powder of Jalap.**

	Definite formula.
Jalap, in No. 60 powder, 35 parts, or	168 grains.
Bitartrate of Potassium, in fine powder, 65 parts, or	312 grains.
To make 100 parts, or	480 grains.

Rub them together until they are thoroughly mixed.

PULVIS MORPHINÆ COMPOSITUS. *U. S.* **Compound Powder of Morphine.** [TULLY'S POWDER.]

	Definite formula.
Sulphate of Morphine, 1 part, or	8 grains.
Camphor, 20 parts, or	160 grains.
Glycyrrhiza, in No. 60 powder, 20 parts, or	160 grains.
Precipitated Carbonate of Calcium, 20 parts, or	160 grains.
Alcohol, a sufficient quantity.	

Rub the Camphor with a little Alcohol, and afterwards with the Glycyrrhiza and Precipitated Carbonate of Calcium, until a uniform powder is produced. Then rub the Sulphate of Morphine with this powder, gradually added, until the whole is thoroughly mixed.

PULVIS RHEI COMPOSITUS. *U. S.* **Compound Powder of Rhubarb.**

	Definite formula.
Rhubarb, in No. 60 powder, 25 parts, or	120 grains.
Magnesia, 65 parts, or	312 grains.
Ginger, in No. 60 powder, 10 parts, or	48 grains.
To make 100 parts, or	480 grains.

Rub them together until they are thoroughly mixed.

Triturationes. *Triturations.*

Triturations constitute a very small class of powders recognized by the Pharmacopœia, but one trituration being officinal. The intention of forming them into a distinct class is to fix a definite relation between the active ingredient and the diluent.

Triturations are to be prepared by the following formula:

Take of	Definite formula.
The Substance, 10 parts, or	6 grains.
Sugar of Milk, in moderately fine powder, 90 parts, or	54 grains.
To make 100 parts, or	60 grains.

Weigh the Substance and Sugar of Milk, separately; then place the Substance, previously reduced, if necessary, to a moderately fine powder, in a mortar; add about an equal bulk of Sugar of Milk, mix well by means of a spatula, and triturate them thoroughly together. Add fresh portions of the Sugar of Milk, from time to time, until the whole is added, and continue the trituration until the Substance is intimately mixed with the Sugar of Milk and finely comminuted.

TRITURATIO ELATERINI. *U. S.* **Trituration of Elaterin.**

	Definite formula.
Elaterin, 10 parts, or	6 grains.
Sugar of Milk, in moderately fine powder, 90 parts, or	54 grains.
To make 100 parts, or	60 grains.

Mix them thoroughly by trituration.

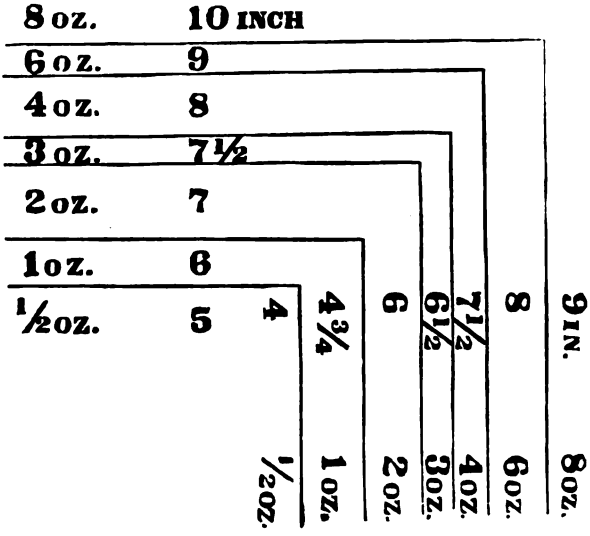
Dispensing of Powders and Solids.

Many of the manipulations required in dispensing powders and solids, such as weighing, measuring, labelling, etc., have been described in previous chapters: therefore only those operations which are peculiar to them, or which have not been considered, will be treated in this chapter.

Folding Packages.—This is one of the first operations taught to the tyro. White paper, of good quality, should be used: it is most economical to buy the paper in quantity (several reams) and have it cut by the

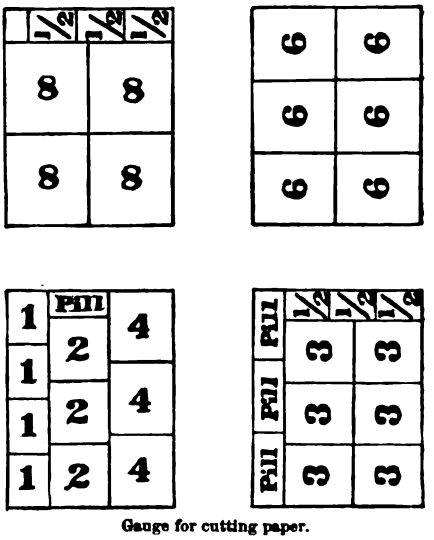
dealer into such sizes as the demands of the business require. The edges of paper which is cut by a machine are much neater than those of hand-cut paper. The size of the sheet of white wrapping-paper is about 36 × 24 inches; this may be cut into halves, quarters, sixths, eighths, and twelfths, or a definite size suited to the bottles and packages adopted may be employed. Jacoby's gauge is useful in this connection: it is illustrated by Figs. 403 and 404. The rectangular lines in Fig. 403 represent the sizes of paper which are suitable for wrapping packages of the sizes indicated,—viz.: 8 oz., 10 × 9 in.; 6 oz., 9 × 8 in.; 4 oz., 8 × 7½ in.; 3 oz., 7½ × 6½ in.; 2 oz., 7 × 6 in.; 1 oz., 6 × 4¾ in.; ½ oz., 5 × 4 in. In Fig. 404 the numbers indicate the method of *cutting a sheet of paper without waste;* the figures 8, 6, 4, 3, 2, etc., refer to the sizes in Fig. 403, and represent papers for 8 oz., 6 oz., 4 oz., 3 oz., etc., packages; the small pieces being used for wrapping pill-boxes.

FIG. 403.



Gauge for cutting paper.

FIG. 404.

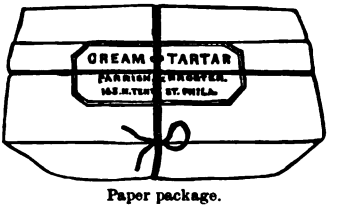


Gauge for cutting paper.

In folding a package, the proper-sized paper is selected and laid upon a flat surface, the substance is deposited in the centre, and the edge nearest the operator is laid against the opposite edge, and a fold made with the thumb and forefinger: the width of the package will depend upon the width of this fold. The end of the partly-formed package on the left hand is now temporarily tucked in, so that the contents shall not fall out, and the package is lifted into an upright position, with the

fold towards the operator; the open upper end is then neatly creased and folded into a wedge-shaped flap. The package is now reversed, and the first partly-formed tuck is loosened and folded into a flap of the same size and shape as the one just made at the other end; the edges of the package are squared and gently pinched into shape, the label is pasted on so that the edge coincides with the edge of the fold, and the package is tied, as shown in Fig. 405.

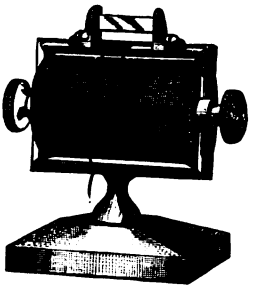
Fig. 405.



Paper package.

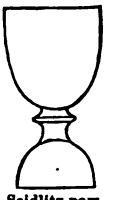
Fig. 406 shows a very convenient twine-reel. Where large quantities of powders having a uniform weight are needed, the powder-measure shown in Fig. 407 may be used. This is made of hard wood, and consists of two ovoid cups of different sizes, joined like an egg-cup. This measure is largely used in preparing seidlitz powders, the larger-sized cup holding the requisite quantity for the alkaline mixture, the smaller cup being intended for the acid.

Fig. 406.



Twine-reel.

Fig. 407.



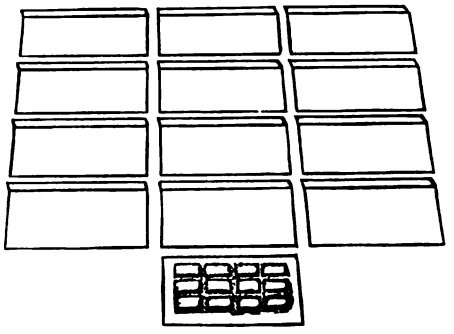
Seidlitz-powder measure.

The measure should never be used without carefully testing its accuracy beforehand. This is done by heaping upon a piece of glazed paper the powder which is to be measured, and then pressing the cup downward through the powder until its edge rests uniformly upon the paper and the measure is evenly filled. The powder will usually have enough cohesive and adhesive properties to cause it to remain in the measure in any position in which it is held. The edge of the cup is then placed upon the powder-paper and slightly tapped, when the contents readily drop out. The weight should be noted, and the operation repeated several times, until the average weight is correctly determined. It will soon be possible, with a little judicious practice, so to regulate the pressure and height of the powder that the variation from the proper weight will practically amount to nothing. This method should not be employed where great accuracy is necessary, and the measure should be repeatedly tested. By use, the edge wears off and the measure holds less: it may be enlarged, however, in the inside by sand-papering it. With due precautions, excellent results may be had by measuring powders, and valuable time saved.

Folding Powders.—This operation is a frequent one, and the practice of accurately dividing powders is one which must be quickly acquired. The best method of attaining proficiency in this respect is to weigh out a definite quantity of a powder (120 grains), and, after dividing it into twelve equal portions, to weigh each portion separately and note the weight, so that any deviation from the proper weight (10 grains) will be discovered. Through practice it will soon be realized that very accurate division may be secured. All the powder-papers

should be creased at once, by folding down a margin on the side, so that they shall be uniform. They should be placed regularly and as close to one another as is convenient. In Fig. 408 the usual arrangement is shown. Where the operator has not sufficient practice to trust to his judgment of the quantity for each powder, the whole quantity may be collected upon a smooth card, flattened into a rectangular shape, and divided with a spatula into the exact number of equal portions required for the number of powder-papers, as shown in Fig. 408. Each portion may then be transferred to its appropriate paper from the card by the spatula.

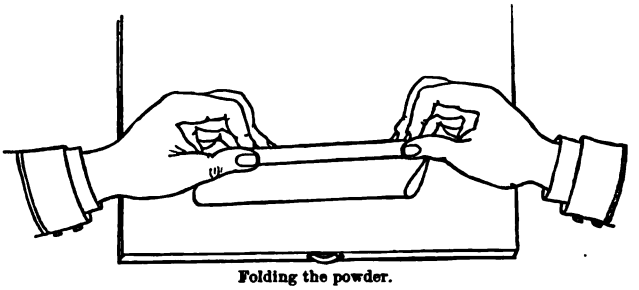
FIG. 408.



Arrangement of powder-papers.

The operation of folding the powder is illustrated in Figs. 409, 410, 411, and 412. The uncreased edge of the paper is brought over so

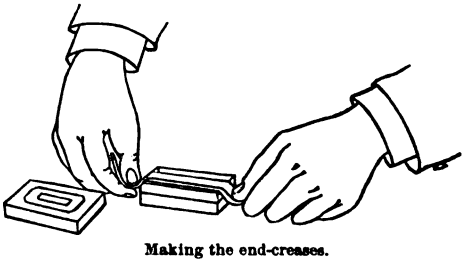
FIG. 409.



Folding the powder.

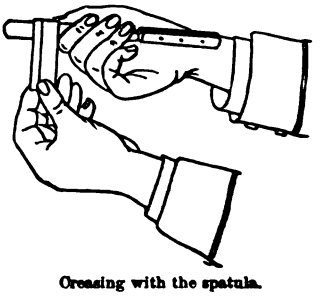
that it lies exactly in the crease, and the fold turned down and folded over towards the operator, the depth of the fold determining the width of the powder.

FIG. 410.



Making the end-creases.

FIG. 411.

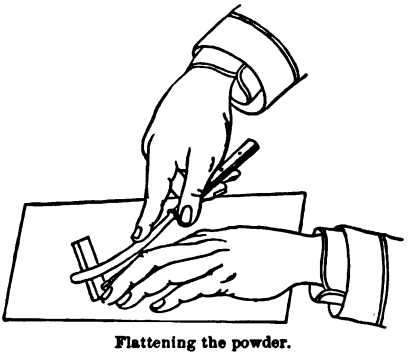


Creasing with the spatula.

When a number of powders are called for, it is best to dispense them in a shallow powder-box (see Fig. 410). It is customary to use the sides

of the box as a gauge. In the hands of an experienced operator neat results are easily obtained in this way, although the use of the powder-folders shown in Figs. 413 and 414 gives a more uniform edge to the powders. A cheap gauge may be made by tacking a piece of

Fig. 412.

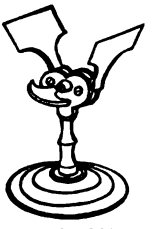


Flattening the powder.

Fig. 413.

Powder-folder.

Fig. 414.



Powder-folder.

tinned iron underneath a convenient shelf, so that a portion having a width slightly less than that of the powder-box will project. A very true edge may be made by folding the powder over a spatula, as shown in Fig. 411, whilst a smooth, flat appearance is given to the powder by pressing down the folds with the blade of the spatula, as shown in Fig. 412. The paper used for folding powders should be thin, glazed cap paper, and for deliquescent substances waxed or paraffin paper should be employed.

Cachets, or Wafer Capsules.

The credit of bringing the *cachet*, or, as it is sometimes termed, *cachet de pain*, into use belongs to Limousin, of Paris. Wafers have been in use many years. Wafer-sheet is made by pouring a mixture of flour and water upon hot greased plates, or between two hot polished cylinders separated at a proper distance, so that the water is evaporated and a sheet of wafer produced. The properties of wafer-sheet admirably fit it for administering nauseous powders. When dry, it is in non-adhesive, stiff, somewhat brittle sheets, slightly thicker than ordinary cardboard. It is tasteless, and harmless when taken into the stomach. When moistened with water, its character is entirely changed: it becomes soft, elastic, and slippery. Powders may be administered by placing a piece of wafer-sheet, after moistening it, upon a tablespoon, and depositing the powder in the centre of the wafer-sheet. The corners are then folded over, so as to enclose it tightly. Water is poured into the tablespoon, and the whole may be swallowed without tasting the powder, the latter, in its enclosure, disappearing as readily as would a small oyster.

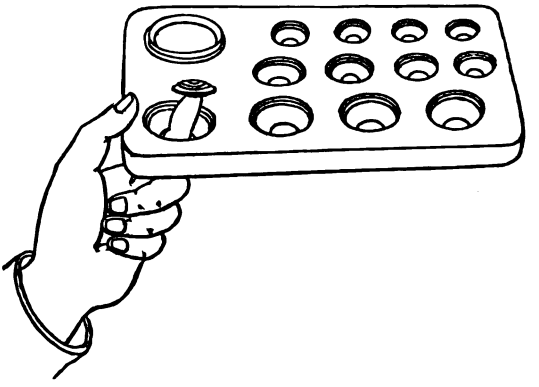
The cachet is an improvement on the above, because no more wafer-sheet is used than is absolutely necessary to enclose the powder, and thus the bulk is diminished. Cachets are lenticular or spoon-shaped disks of wafer-sheet, of various sizes. The powder is deposited in the dry cachet, and the margin is moistened with water. An empty cachet of

exactly the same size is placed on top, with the convexity upward, and pressure is made upon the margin, with the effect of tightly sealing the cachet and enveloping the powder. Elaborate apparatus—the necessity for which, however, is not apparent—has been devised to effect the sealing of the cachets. The simplest method upon the small scale is as fol-

FIG. 415.

Bottles for sealing cachets.

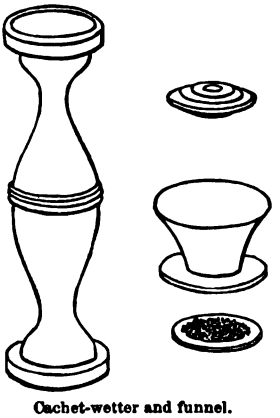
FIG. 416.



Limousin's cachet-board.

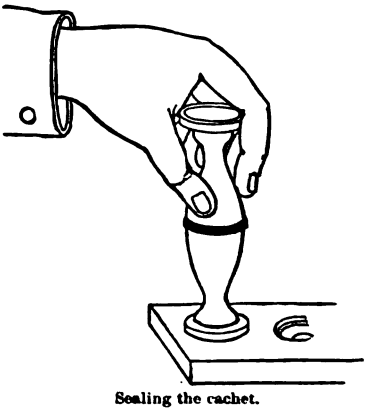
lows: two bottles are provided (a morphine-bottle for the middle size answers very well), and, one of the cachets being placed upon the lip of one bottle, the powder is carefully deposited in the centre without soiling the outside edge; the margin of an empty cachet of the same size is then

FIG. 417.



Cachet-wetter and funnel.

FIG. 418.



Sealing the cachet.

moistened by quickly passing it over a piece of wet felt, and is laid upon the cachet containing the powder; the lip of the other bottle is now applied to the cachet with sufficient pressure to seal it effectually. The position of the bottles is shown in Fig. 415. Limousin's improved method is similar in principle, although, of course, more finished. A

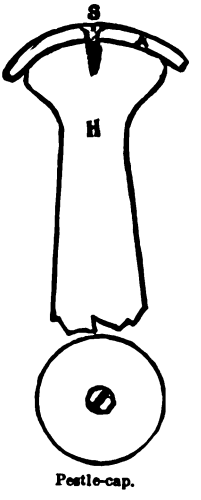
board, with depressed perforations for three sizes, is shown in Fig. 416. Empty cachets are placed upon the depressions, and the powder is deposited in the centre with the aid of the small powder-funnel (see Fig. 417). The "wetter and presser" is shown to the left of the funnel; this is of two kinds of wood, joined in the middle,—one end being hard, light-colored, and highly polished, the other being dark-colored and somewhat absorbent. The end of the latter is used to moisten the margin of the cachet, by first placing it upon a piece of moist felt and then applying it to the cachet; an empty cachet is now laid upon the one containing the powder, and the "presser" end is applied with some force, so as to seal the cachet (see Fig. 418): the sealed cachet is pushed up from below, as shown in Fig. 416.

Trochisci. *Troches.*

Troches, or lozenges, are solid, discoid or cylindrical masses, consisting chiefly of medicinal powders, sugar, and mucilage. They are intended to be used by placing them in the mouth and permitting them to remain until, through slow solution or disintegration, their purpose of mild medication is effected. It is obvious that very powerful or disagreeable remedies cannot be administered in this way. The formation of the "lozenge mass" is the most important part of the operation: the dry powders must be made into a tenacious mass which shall possess sufficient plasticity to enable it to be rolled into a flat cake without crumbling: it must not retain moisture so long as to occasion too much delay in drying the troches, and the troches must not be brittle through want of sufficient adhesiveness. Mucilage of tragacanth has been found best to serve the purpose of causing the adhesion of the powders.

Making the Mass.—The best method of making the mass is first to prepare the mucilage according to the formula, and, having mixed and sifted the powders, add sufficient mucilage to make a mass of the proper consistence: the quantity always depends upon the character of the powder: if the latter is absorbent, more mucilage is required than if the powder is made up largely of extracts. The usual method of mixing powdered tragacanth or acacia with the dry powders, and then trusting to the addition of the right proportion of water, is generally disappointing in the hands of the inexperienced, almost invariably producing too moist a mass. Upon the large scale the manufacturer employs a mixing-machine to form the mass; upon the small scale the pharmacist uses the mortar and pestle. The mortar-clamp shown in Fig. 361 is very useful in this connection and in working tough masses. Hahn's pestle-cap will save blistering the hands of the inexperienced: this device, shown in Fig. 419, consists of a brass cup-shaped cap, A, perforated in the centre, and screwed to the top of the pestle H at S, so as to permit of the slow revolution of the cap when the pestle is tightly grasped in the hand.

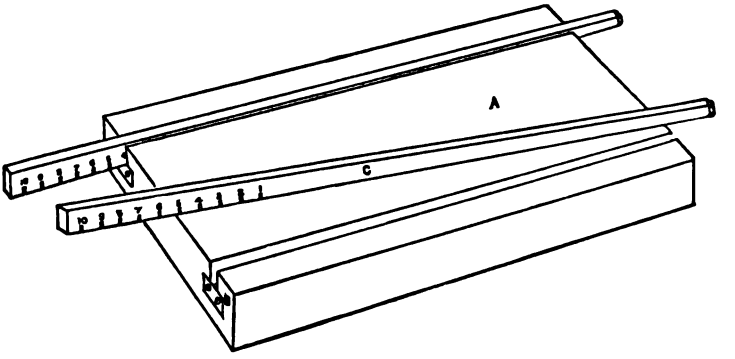
FIG. 419.



Pestle-cap.

Rolling the Mass.—When the mass is made, it must be formed into a flat cake by placing it upon a hard, level, dusted surface and rolling

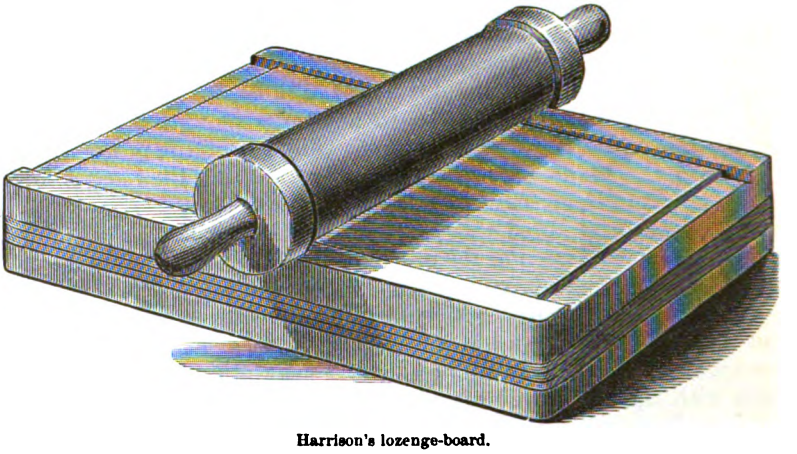
FIG. 420.



Slocum's lozenge-board.

it with a cylindrical roller: the thickness of the cake determines the weight of the lozenge, and hence it is more exact to have some means

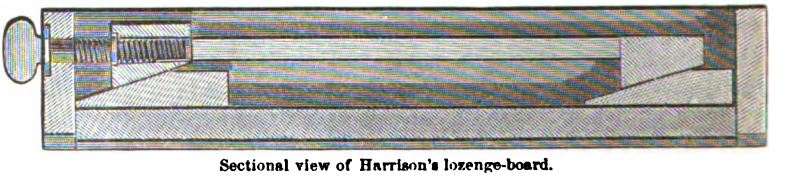
FIG. 421.



Harrison's lozenge-board.

of adjusting the thickness. In Slocum's lozenge-board (see Fig. 420) this is ingeniously effected by the use of tapering oak strips, C, which

FIG. 422.



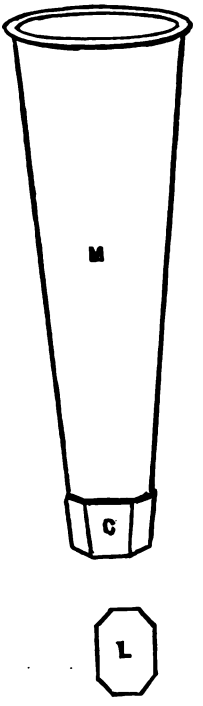
Sectional view of Harrison's lozenge-board.

slide in inclined furrows; the handles of the strips are graduated, having saw-kerfs at regular intervals; the brass plate B permits these to be

accurately adjusted and held, so that both strips project uniformly above the board. By pushing both strips forward, greater thickness of the lozenge-cake is secured.

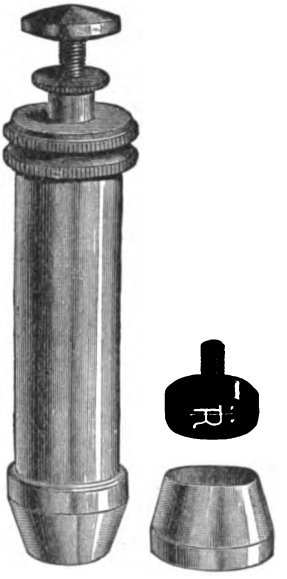
Harrison's lozenge-board is shown in Fig. 421 and Fig. 422. The

FIG. 424.



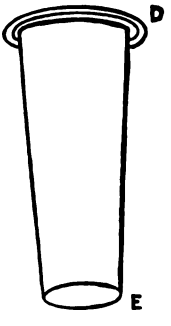
Lozenge-punch, steel cutter.

FIG. 425.



Lozenge-cutter, with die.

FIG. 423.



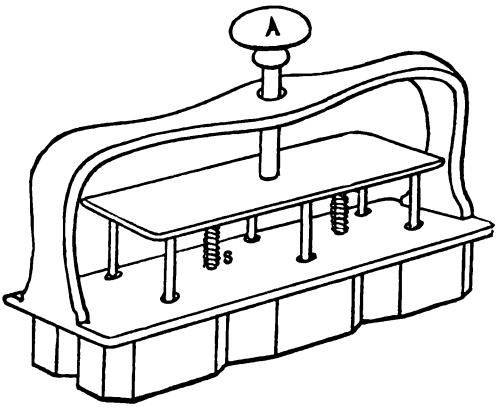
Tinned-iron lozenge-punch.

board is surrounded by a frame, and the former can be elevated or depressed uniformly by turning the screw shown in the sectional view in Fig. 422. The handles of the roller form one continuous piece, running through a longitudinal hole through its centre: this permits the handles to be grasped tightly whilst the roller revolves. Lozenge-rollers should be true cylinders, and are generally made of hard wood: steel rollers and glass rollers have been used, however; these are both made hollow, so that hot water can be introduced through the holes made where the handles are screwed in.

Cutting the Troches.—Troches are cut by cylindrical or conical punches, often made of tinned iron, as shown in Fig. 423, but preferably of steel, as the latter produce troches having a cleaner edge. Fig. 424 shows a very good punch, having a hardened steel octagonal cutter, C, soldered to a hollow conical handle, M. Fig. 425 represents a very complete lozenge-cutter with a circular die, which stamps a letter upon the lozenge in addition to cutting it. It was obtained by the author from Chicago. It is made very substantially, and is accom-

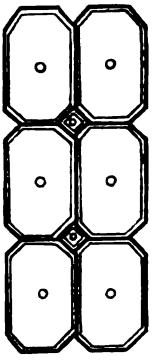
panied by a cutter and die for oval lozenges. Fig. 426 shows an excellent cutter, which accurately cuts six lozenges at once: it was devised by a Western pharmacist. Fig. 427 gives the end-view. The cutter is

FIG. 426.



Lozenge-cutter.

FIG. 427.



End-view of the same.

placed upon the soft mass and pressed down until the edges touch the board; by pressing upon the handle A the lozenges are forced out of the cutters, the springs S causing the pushers to resume their original position.

TROCHISCI ACIDI TANNICI. *U.S.* **Troches of Tannic Acid.**

	Grains.	Grammes.
Tannic Acid, *one hundred grains*	100	6.50
Sugar, in fine powder, *one thousand grains*	1000	65.00
Tragacanth, in fine powder, *twenty-five grains*	25	1.60
Orange Flower Water, *a sufficient quantity,*		
To make *one hundred troches*	100	

Rub the powders together until they are thoroughly mixed; then, with Orange Flower Water, form a mass, to be divided into *one hundred troches.*

TROCHISCI AMMONII CHLORIDI. *U.S.* **Troches of Chloride of Ammonium.**

	Grains.	Grammes.
Chloride of Ammonium, in fine powder, *two hundred grains*	200	13.00
Sugar, in fine powder, *one thousand grains*	1000	65.00
Tragacanth, in fine powder, *twenty-five grains*	25	1.60
Syrup of Tolu, *a sufficient quantity,*		
To make *one hundred troches*	100	

Rub the powders together until they are thoroughly mixed; then, with Syrup of Tolu, form a mass, to be divided into *one hundred troches.*

TROCHISCI CATECHU. *U. S.* **Troches of Catechu.**

	Grains.	Grammes.
Catechu, in fine powder, *one hundred grains*	100	6.50
Sugar, in fine powder, *one thousand grains*	1000	65.00
Tragacanth, in fine powder, *twenty-five grains*	25	1.60
Orange Flower Water, *a sufficient quantity,*		
To make *one hundred troches*	100	

Rub the powders together until they are thoroughly mixed; then, with Orange Flower Water, form a mass, to be divided into *one hundred troches.*

TROCHISCI CRETÆ. *U. S.* **Troches of Chalk.**

	Grains.	Grammes.
Prepared Chalk, *four hundred grains*	400	26.00
Acacia, in fine powder, *one hundred grains*	100	6.50
Nutmeg, in fine powder, *fifteen grains*	15	1.00
Sugar, in fine powder, *six hundred grains*	600	39.00
To make *one hundred troches*	100	

Rub them together until they are thoroughly mixed; then, with water, form a mass, to be divided into *one hundred troches.*

TROCHISCI CUBEBÆ. *U. S.* **Troches of Cubeb.**

	Grains.	Grammes.
Oleoresin of Cubeb, *fifty grains*	50	3.25
Oil of Sassafras, *fifteen grains*	15	1.00
Extract of Glycyrrhiza, in fine powder, *four hundred grains*	400	26.00
Acacia, in fine powder, *two hundred grains*	200	13.00
Syrup of Tolu, *a sufficient quantity,*		
To make *one hundred troches*	100	

Rub the powders together until they are thoroughly mixed; then add the Oleoresin and Oil, and incorporate them with the mixture. Lastly, with Syrup of Tolu, form a mass, to be divided into *one hundred troches.*

TROCHISCI FERRI. *U. S.* **Troches of Iron.**

	Grains.	Grammes.
Hydrated Oxide of Iron, dried at a temperature not exceeding 80° C. (176° F.), *five hundred grains*	500	32.50
Vanilla, cut into slices, *ten grains*	10	0.65
Sugar, in fine powder, *fifteen hundred grains*	1500	97.50
Mucilage of Tragacanth, *a sufficient quantity,*		
To make *one hundred troches*	100	

Rub the Vanilla, first, with a portion of the Sugar to a uniform powder, and afterward, with the Oxide of Iron and the remainder of the Sugar, until they are thoroughly mixed. Then, with Mucilage of Tragacanth, form a mass, to be divided into *one hundred troches.*

TROCHISCI GLYCYRRHIZÆ ET OPII. *U. S.* **Troches of Glycyrrhiza and Opium.**

	Grains.	Grammes.
Extract of Glycyrrhiza, in fine powder, *two hundred grains*	200	13.00
Extract of Opium, in fine powder, *five grains*	5	0.32
Acacia, in fine powder, *two hundred grains*	200	13.00
Sugar, in fine powder, *three hundred grains*	300	19.50
Oil of Anise, *three grains*	3	0.20
To make *one hundred troches*	100	

Rub the powders together until they are thoroughly mixed; then add the Oil of Anise, and incorporate it with the mixture. Lastly, with water, form a mass, to be divided into *one hundred troches.*

TROCHISCI IPECACUANHÆ. *U.S.* Troches of Ipecac.

	Grains.	Grammes.
Ipecac, in fine powder, *twenty-five grains*	25	1.60
Tragacanth, in fine powder, *twenty-five grains*	25	1.60
Sugar, in fine powder, *one thousand grains*	1000	65.00
Syrup of Orange, *a sufficient quantity,*		
To make *one hundred troches*	100	

Rub the powders together until they are thoroughly mixed; then, with Syrup of Orange, form a mass, to be divided into *one hundred troches.*

TROCHISCI KRAMERIÆ. *U.S.* Troches of Krameria.

	Grains.	Grammes.
Extract of Krameria, *one hundred grains*	100	6.50
Sugar, in fine powder, *one thousand grains*	1000	65.00
Tragacanth, in fine powder, *twenty-five grains*	25	1.60
Orange Flower Water, *a sufficient quantity,*		
To make *one hundred troches*	100	

Rub the powders together until they are thoroughly mixed; then, with Orange Flower Water, form a mass, to be divided into *one hundred troches.*

TROCHISCI MAGNESIÆ. *U.S.* Troches of Magnesia.

	Grains.	Grammes.
Magnesia, *three hundred grains*	300	19.50
Nutmeg, in fine powder, *fifteen grains*	15	1.00
Sugar, in fine powder, *nine hundred grains*	900	58.50
Mucilage of Tragacanth, *a sufficient quantity,*		
To make *one hundred troches*	100	

Rub the Magnesia and the powders together until they are thoroughly mixed; then, with Mucilage of Tragacanth, form a mass, to be divided into *one hundred troches.*

TROCHISCI MENTHÆ PIPERITÆ. *U.S.* Troches of Peppermint.

	Grains.	Grammes.
Oil of Peppermint, *fifteen grains*	15	1.00
Sugar, in fine powder, *twelve hundred grains*	1200	78.00
Mucilage of Tragacanth, *a sufficient quantity,*		
To make *one hundred troches*	100	

Rub the Oil of Peppermint and the Sugar together until they are thoroughly mixed; then, with Mucilage of Tragacanth, form a mass, to be divided into *one hundred troches.*

TROCHISCI MORPHINÆ ET IPECACUANHÆ. *U. S.* Troches of Morphine and Ipecac.

	Grains.	Grammes.
Sulphate of Morphine, *five grains*	5	0.32
Ipecac, in fine powder, *sixteen grains*	16	1.00
Sugar, in fine powder, *two thousand grains*	2000	130.00
Oil of Gaultheria, *two grains*	2	0.13
Mucilage of Tragacanth, *a sufficient quantity,*		
To make *two hundred troches*	200	

Rub the powders together until they are thoroughly mixed; then add the Oil of Gaultheria, and incorporate it with the mixture. Lastly, with Mucilage of Tragacanth, form a mass, to be divided into *two hundred troches.*

TROCHISCI POTASSII CHLORATIS. *U. S.* Troches of Chlorate of Potassium.

	Grains.	Grammes.
Chlorate of Potassium, in fine powder, *five hundred grains*	500	32.50
Sugar, in fine powder, *nineteen hundred grains*	1900	124.00
Tragacanth, in fine powder, *one hundred grains*	100	6.50
Spirit of Lemon, *ten grains*	10	0.65
To make *one hundred troches*	100	

Mix the Sugar with the Tragacanth and the Spirit of Lemon by trituration, in a mortar; then transfer the mixture to a sheet of paper, and, by means of a bone spatula, mix with it the Chlorate of Potassium, being careful to avoid trituration and pressure, to prevent the mixture from igniting or exploding. Lastly, with water, form a mass, to be divided into *one hundred troches.*

TROCHISCI SODII BICARBONATIS. *U. S.* Troches of Bicarbonate of Sodium.

	Grains.	Grammes.
Bicarbonate of Sodium, *three hundred grains*	300	19.50
Sugar, in fine powder, *nine hundred grains*	900	58.50
Nutmeg, in fine powder, *fifteen grains*	15	1.00
Mucilage of Tragacanth, *a sufficient quantity,*		
To make *one hundred troches*	100	

Rub the Bicarbonate of Sodium with the powders until they are thoroughly mixed; then, with Mucilage of Tragacanth, form a mass, to be divided into *one hundred troches.*

TROCHISCI SODII SANTONINATIS. *U. S.* Troches of Santoninate of Sodium.

	Grains.	Grammes.
Santoninate of Sodium, in fine powder, *one hundred grains*	100	6.50
Sugar, in fine powder, *two thousand grains*	2000	130.00
Tragacanth, in fine powder, *fifty grains*	50	3.25
Orange Flower Water, *a sufficient quantity,*		
To make *one hundred troches*	100	

Rub the powders together until they are thoroughly mixed; then, with Orange Flower Water, form a mass, to be divided into *one hundred troches.*

Troches of Santoninate of Sodium should be kept in dark amber-colored vials.

TROCHISCI ZINGIBERIS. *U. S.* Troches of Ginger.

	Grains.	Grammes.
Tincture of Ginger, *two hundred grains*	200	13.00
Tragacanth, in fine powder, *fifty grains*	50	3.25
Sugar, in fine powder, *two thousand grains*	2000	130.00
Syrup of Ginger, *a sufficient quantity,*		
To make *one hundred troches*	100	

Mix the Tincture of Ginger with the Sugar, and, having exposed the mixture to the air until dry, reduce it to a fine powder; to this add the Tragacanth, and mix thoroughly. Lastly, with Syrup of Ginger, form a mass, to be divided into *one hundred troches.*

Confectiones. *Confections.*

Confections are saccharine, soft solids, in which one or more medicinal substances are incorporated with the object of affording an agreeable form for their administration and a convenient method for their preservation. Under the old names of *conserves* and *electuaries,* these preparations have been in use for centuries. In the preparation of confections the basis is finely-powdered sugar, and the medicinal ingredients must be brought to the condition of a smooth paste or introduced as a fine powder or liquid. Only two confections are officinal.

Officinal Confections.

Name.	Proportions.
Confectio Rosæ.	8 parts Red Rose, in No. 60 powder; 64 parts Powdered Sugar; 12 parts Clarified Honey; 16 parts Rose Water.
Confectio Sennæ.	10 parts Senna, in No. 60 powder; 6 parts Coriander, in No. 40 powder; 16 parts Cassia Fistula, bruised; 10 parts Tamarind; 7 parts Prune; 12 parts Fig, bruised; 50 parts Powdered Sugar; 60 parts Water.

CONFECTIO ROSÆ. *U. S.* Confection of Rose.

	Definite formula.
Red Rose, in No. 60 powder, 8 parts, or	1 oz. av.
Sugar, in fine powder, 64 parts, or	8 oz. av.
Clarified Honey, 12 parts, or	1½ oz. av.
Rose Water, 16 parts, or	2 fl. oz.
To make 100 parts, or	12½ oz. av.

Rub the Red Rose with the Rose Water heated to 65° C. (149° F.), then gradually add the Sugar and Honey, and beat the whole together until thoroughly mixed.

CONFECTIO SENNÆ. *U. S.* **Confection of Senna.**

	Definite formula.
Senna, in No. 60 powder, 10 parts, or	700 grains.
Coriander, in No. 40 powder, 6 parts, or	420 grains.
Cassia Fistula, bruised, 16 parts, or	2½ oz. av.
Tamarind, 10 parts, or	700 grains.
Prune, sliced, 7 parts, or	490 grains.
Fig, bruised, 12 parts, or	2 oz. av.
Sugar, in fine powder, 50 parts, or	8 oz. av.
Water, 60 parts, or	9 fl. oz.
To make 100 parts, or	16 oz. av.

Place the Cassia Fistula, Tamarind, Prune, and Fig in a close vessel with *forty-five parts* [or 6½ fl. oz.] of the Water, and digest for three hours, by means of a water-bath. Separate the coarser portions with the hand, and rub the pulpy mass, first through a coarse hair sieve, and then through a fine one, or through a muslin cloth. Mix the residue with the remainder of the Water, and, having digested the mixture for a short time, treat it as before, and add the product to the pulpy liquid first obtained. Then, by means of a water-bath, dissolve the Sugar in the pulpy liquid, and evaporate the whole until it weighs *eiyhty-four parts* [or 13½ oz. av.]. Lastly, add the Senna and Coriander, and incorporate them thoroughly with the other ingredients while yet warm.

Massæ. *Masses.*

Pill masses are officinal in the U.S. Pharmacopœia under the title of "massa." As the officinal preparations are usually kept in bulk by pharmacists, and are permanent preparations, there is a manifest propriety and convenience in making a distinct class of them. There are three officinal masses.

Officinal Masses.

Name.	Proportions.	Preparation.
Massa Copaibæ.	94 parts Copaiba; 6 parts Magnesia (recently prepared).	Mix them intimately, and set the mixture aside until it concretes into a pilular mass.
Massa Ferri Carbonatis.	100 parts Sulphate of Iron; 110 parts Carbonate of Sodium; 38 parts Clarified Honey; 25 parts Sugar, in coarse powder; Syrup and Distilled Water, of each, a sufficient quantity.	Dissolve the Sulphate of Iron and the Carbonate of Sodium separately in boiling Distilled Water, add 25 parts Syrup to the Solution of Sulphate of Iron, and mix the solutions. When cold, pour off the supernatant liquid, and wash the precipitate with a mixture of 1 part of Syrup to 16 parts of Water. Drain the precipitate, mix it with the Honey and Sugar, and evaporate to 100 parts.
Massa Hydrargyri.	33 parts Mercury; 5 parts Glycyrrhiza, powdered; 25 parts Althæa, powdered; 3 parts Glycerin; 34 parts Honey of Rose.	Triturate the Mercury with the Honey of Rose and Glycerin until it is extinguished, add gradually the Glycyrrhiza and Althæa, and continue the trituration until globules of Mercury cease to be visible.

MASSA COPAIBÆ. *U.S.* **Mass of Copaiba.** [PILULÆ COPAIBÆ, Pharm. 1870.]

	Definite formula.
Copaiba, 94 parts, or	4 oz. av.
Magnesia, recently prepared, 6 parts, or	112 grains.
To make 100 parts, or . . . about	4¼ oz. av.

Mix them intimately, and set the mixture aside until it concretes into a pilular mass.

Should the mixture not concrete in eight or ten hours, a deficiency of water in the Copaiba may be inferred; and this difficulty may be obviated, in subsequent operations, by shaking the Copaiba with one-twentieth of its weight of water, allowing it to stand until all the uncombined water has subsided, and then decanting and keeping it in closed bottles for use.

MASSA FERRI CARBONATIS. *U.S.* **Mass of Carbonate of Iron.**
[PILULÆ FERRI CARBONATIS, Pharm. 1870.]

	Definite formula.
Sulphate of Iron, 100 parts, or	8 oz. av.
Carbonate of Sodium, 110 parts, or	8 oz. av. 350 grains.
Clarified Honey, 88 parts, or	3 oz. av.
Sugar, in coarse powder, 25 parts, or	2 oz. av.
Syrup,	
Distilled Water, each, a sufficient quantity,	
To make 100 parts, or	8 oz. av.

Dissolve the Sulphate of Iron and the Carbonate of Sodium separately, each in *two hundred parts* [or 1 pint] of boiling Distilled Water, and, having added *twenty-five parts* [or 1½ fl. oz.] of Syrup to the solution of the iron salt, filter both solutions. Mix them, when cold, in a bottle just large enough to hold them, or add enough Distilled Water to fill it; close the bottle accurately with a stopper, and set it aside so that the carbonate of iron may subside. Pour off the supernatant liquid, and, having mixed Syrup and Distilled Water in the proportion of *one part* [or 6 fl. dr.] of Syrup to *sixteen parts* [or 1 pint] of Water, wash the precipitate with the mixture until the washings no longer have a saline taste. Drain the precipitate on a flannel cloth, and express as much of the Water as possible. Lastly, mix the precipitate immediately with the Honey and Sugar, and, by means of a water-bath, evaporate the mixture, constantly stirring, until it is reduced to *one hundred parts* [or 8 oz. av.].

MASSA HYDRARGYRI. *U.S.* **Mass of Mercury.** [PILULÆ HYDRARGYRI, Pharm. 1870. BLUE MASS. BLUE PILL.]

	Definite formula.
Mercury, 33 parts, or	5 oz. av. 122 grains.
Glycyrrhiza, in No. 60 powder, 5 parts, or	350 grains.
Althæa, in No. 60 powder, 25 parts, or	4 oz. av.
Glycerin, 3 parts, or	3 fl. dr.
Honey of Rose, 34 parts, or	4½ fl. oz.
To make 100 parts, or	16 oz. av.

Triturate the Mercury with the Honey of Rose and Glycerin until it is extinguished. Then gradually add the Glycyrrhiza and Althæa, and continue the trituration until globules of Mercury cease to be visible under a lens magnifying ten diameters.

Pilulæ. *Pills.*

Pills are small, solid bodies, of a globular, ovoid, or lenticular shape, which are intended to be swallowed and thereby produce medicinal action. Pills are more largely used than any other form of solid preparations: substances which are bitter or unpleasant to the taste, if not corrosive or deliquescent, can be administered in this form if the dose is not too large. The ease and rapidity with which pills can be administered, the length of time during which they retain their original activity, their compact form, and their absence of unpleasant taste when coated, are the principal reasons for their extended use.

In order to give medicinal substances the requisite shape and consistence to form pills, they must be brought into a soft condition and made into a mass, generally through the use of a volatile liquid: the subsequent evaporation of this liquid, or a portion of it, should produce but little change in the form of the pill. As previously stated (page 966), pill masses are sometimes kept in bulk and made into pills when occasion requires: by far the greatest number, however, are made extemporaneously, and the exercise of the knowledge and perception which are necessary in selecting the proper substance to form the mass constitutes one of the most important duties of the pharmacist. To be able always to select the proper excipient requires a thorough knowledge of the physical properties of all the articles of the materia medica which enter into the composition of pill masses.

Forming the Mass.—The mass consists of two parts: 1. The active ingredients. 2. The excipient, or the substance used to form the mass and give it the proper consistence. The essential requirements of a pill mass are that it shall be—1, *adhesive;* 2, *firm;* and, 3, *plastic.*

1. **The mass must be sufficiently adhesive** to retain its shape and yet be soft enough to be worked by the fingers or suitable apparatus into the desired form: to enable it to possess adhesiveness, a liquid is usually added to the powdered ingredients, and the selection of this liquid must always depend upon the physical character of the ingredients; in many cases the latter possess sufficient adhesiveness in themselves if they are moistened with water, and hence the quality is *only developed,*—not created, as in the case of powders containing extracts; others, again, are totally devoid of adhesiveness, and sticky substances, like gum, sugar, etc., must be added in sufficient quantity to supply the deficiency. Some substances may be made soft and adhesive by simply heating them, and they regain their original condition when allowed to cool.

2. **The mass must possess sufficient firmness** to permit the pills to retain their shape. The condition of adhesiveness is usually dependent upon the addition of a liquid which dissolves *a small portion* of the solid ingredients, and this solution is adhesive enough to enable the mass to be made; but if too much liquid be added, the quality of firmness will be lost, and the pills either cannot be formed at all, or will subsequently run together in the box. The physical properties of the active ingredients of the pill must be thoroughly understood to

judge of the proper quantity of excipient to be used to give adhesiveness without losing firmness. The following general rule may serve to guide the operator: *Never use an excipient alone which is a perfect solvent for the solid substances:* for instance, water should not be used *alone* for making pills of the *soluble* scaled-iron salts; for, although the pills may apparently be firm enough when dispensed, they will be very apt in warm weather to run together in the box: if sufficient acacia be used with the water, they can be made to retain their shape.

3. **The mass must be plastic.**—The condition of plasticity is a natural result of the possession of a proper degree of adhesiveness and firmness: many substances may be formed into a mass which will be either adhesive or firm, but unless these conditions are properly balanced, so that the mass can be quickly and easily formed into pills which will retain their shape without flattening, pills cannot be made successfully. Plasticity can generally be secured by thoroughly working or kneading the mass: in this connection see Fig. 361. The choice of the excipient is usually left entirely to the pharmacist, and in making the selection care should be taken that, whilst the pharmaceutical requisites are fulfilled, the proper solubility or disintegrability of the pill in the stomach is not lost sight of.

Choice of the Excipient.—An examination of the following list of excipients will probably convey a good idea of their uses: they are divided into two classes, liquid and solid. Liquid excipients are generally preferred, because they are more conveniently added to the powders.

List of Excipients.

Liquid.

Water.	Used only when the ingredients of the pill possess sufficient adhesiveness to be developed by the water.
Syrup.	An excellent excipient when more adhesiveness is needed than can be afforded by the use of water.
Syrup of Acacia.	Better than syrup, because it is more adhesive, and can be used in smaller quantity. The objection to its use is that the pills made with it are apt to become very hard, and in some cases they may be practically insoluble in the liquids of the stomach.
Mucilage of Acacia.	More adhesive than any of the preceding, but open to the same objection as syrup of acacia.
Glycerin.	Somewhat adhesive, but very valuable, because its hygroscopic properties prevent the pills made with it from becoming hard. It is rarely advisable to use it alone, however, as the surfaces of the pills often acquire a dampness which attracts the particles of dusting-powder.
Glucose.	A very valuable excipient: it is colorless, very adhesive, and practically non-volatile at ordinary temperatures.
Honey.	May be used in place of glucose for dark-colored masses, but quinine pills are not white when honey is used as the excipient.
Extract of Malt.	Has the advantages of glucose, but the disadvantage of honey in not being colorless.
Glycerite of Starch.	Possesses the merits of glycerin, with the adhesiveness of the starch jelly. Its thick consistence is sometimes an inconvenience (see page 275).
Glycerite of Tragacanth.	Similar to glycerite of starch.
General Excipient.	Suggested by the author as combining the advantages of several of the above (see page 969).

Solid.

Confection of Rose.	Useful when a small quantity of an active ingredient is to be made into pills and dilution is necessary, as in pills of strychnine, podophyllin, etc. Its bulkiness is its principal disadvantage for general work.

List of Excipients.—(*Continued.*)

Crumb of Bread.	Valuable for very powerful liquids, like croton oil, volatile oils, etc.
Powdered Althæa.	Gives adhesiveness, and is useful as an absorbent, but is bulky.
Soap.	A very valuable excipient for resinous substances. It increases their solubility, and forms an unexceptionable mass.
Resin Cerate.	Valuable for oxidizable substances, resins, etc.
Cacao Butter.	Used for pills of permanganate of potassium and similar substances.
Petrolatum.	Used for oxidizable substances like the two preceding excipients.

General Excipient for Pills.

The following excipient is recommended as possessing several advantages. It is a colorless, permanent, very adhesive liquid; the pills made with it are small; and the proportion of glycerin is not large enough to make the surfaces of the pills hygroscopic in an ordinary atmosphere:

Glucose (white, pure)	4 oz. av.
Glycerin	1 oz. av.
Acacia (powdered, best)	90 grains.
Benzoic Acid	1 grain.

Dissolve the Benzoic Acid in the Glycerin contained in a small tared capsule, add the Acacia with stirring, and then the Glucose, and allow the mixture to stand until the Acacia is dissolved: a *moderate* heat may be applied to hasten solution. The benzoic acid is used as an antiseptic; if the excipient is made in small quantities and frequently, it may be omitted.

FIG. 428.

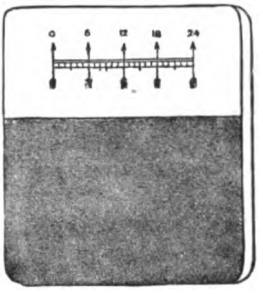
Excipient-bottle.

In Fig. 428 a simple but effective excipient-bottle is shown: it is made from a plain morphine bottle, C; a piece of sheet-rubber cloth, such as is used for making washers, is cut into a disk, R, slightly larger in diameter than the mouth of the bottle; a hole in the centre permits the introduction of a round, slightly tapering wooden rod, H, or, if preferred, a solid glass rod: it is obvious that as the excipient is used the rod may be slipped down so as always to dip into the excipient a certain distance, and thus the quantity adhering to the end can be easily adjusted. One of the merits of this simple device is that all parts of it can be easily renewed and kept clean.

Dividing the Mass.—Upon the small scale the pill-tile may be used for this operation (see Fig. 429): this is usually made of queen's-ware or porcelain. The objection to this material, however, is that some substances will penetrate through the little fissures in the tile and soil it: these are often very difficult to dislodge, and they usually give the tile a dirty appearance, in spite of the most diligent washing. A few years since, Whitall, Tatum & Co. made, at the author's suggestion, a pill-tile from plate-glass, having the scale graduated by an engraver's wheel, and a little over one-half of its surface ground so

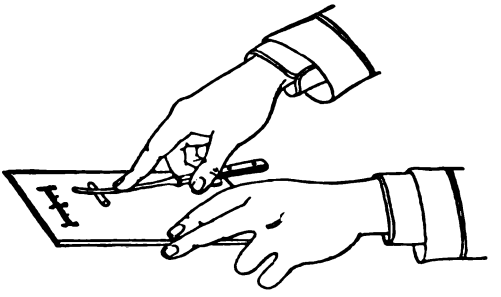
that the pill-cylinder would not slip: this makes an unexceptionable surface. The pill mass is placed upon the tile and rolled into a cylinder, either with a smooth, flat board or a spatula, as shown in Fig. 430: it

FIG. 429.



Pill-tile

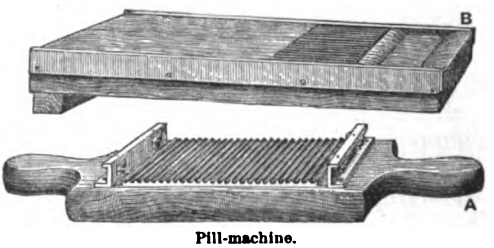
FIG. 430.



Rolling a pill-cylinder.

is then placed upon the graduated scale and cut with the spatula into the desired number of pieces. The pill-machine is preferred in making larger quantities of pills; indeed, many pharmacists never use a pill-tile, but divide and cut all their pills with a machine: this consists of two hard-wood boards, one of which is encased in a metal frame (to prevent warping); a brass plate having hemispherical grooves is fastened to one end of the lower board (B), and a similar plate is adjusted to the upper board (A), which is furnished with handles at the end; brass guides are attached to the upper board, to cause the cutting surfaces of the grooves on both boards to correspond (see Fig. 431). The pill mass is rolled into a cylinder and laid upon the grooves of the lower board; the upper board is then applied so that the cutting surfaces correspond with those of the lower board, and, by a slight backward and forward motion with downward pressure, the mass is divided.

FIG. 431.

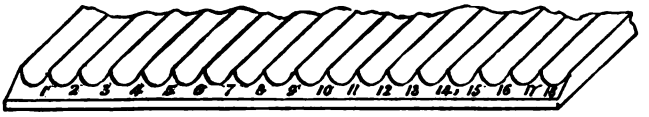


Pill-machine.

When a smaller number of pills are needed than the full capacity of the cutters indicates, the cylinder is rolled out merely to the length necessary to make the desired quantity. In using the pill-machine in this way a common annoyance is experienced, however, in having either to count off the number of grooves each time, or to deface the board with lines. The simple expedient proposed by the author in 1875, and shown in Fig. 432, obviates this. The lower cutter is removed from the board, and its edge is bevelled off so that sufficient space may be gained to stamp a small figure below each cutting edge. Pill-machines with this addition may be had from A. H. Wirz & Son, of Philadelphia. The Cooper pill-machine is so constructed that but one lower

and one upper board are necessary for making several sizes of pills: this object is effected by making the cutters for the various sizes removable and adjustable.

FIG. 432.

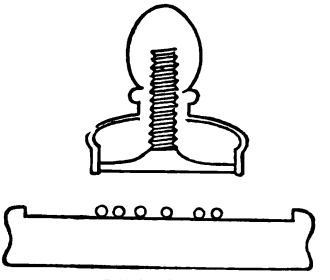


Pill-cutter with numbered edge.

Dusting-Powder.—To prevent the pill-cylinder from sticking to the board or tile, and to lessen the friction, some absorbent powder is dusted upon the surfaces: this may be rice flour, powdered magnesium carbonate, lycopodium, powdered althæa, or powdered liquorice root. Rice flour is preferable for white pills, because its presence is not easily recognized, and because the cylinder does not slip, as it usually does when lycopodium is used.

Finishing the Pills.—Many efforts have been made to supply effective mechanical devices for finishing pills, yet the fact remains that the pharmacist usually prefers to roll and finish them with his fingers. If a finisher is desired, a level surface having a raised rim may be used, and the pills enclosed, and rotated by the adjustable pill-finisher shown in Fig. 433.

FIG. 433.



Pill-finisher.

When large quantities of pills are made, they are usually dried by rolling them in some absorbent powder, spreading them out, and exposing them to dry air.

Dispensing Pills.—Pills are usually dispensed in flat circular boxes: these should be made so shallow that the pills cannot lie on top of one another. Square pill-boxes are coming into use, and are preferred to round boxes for several reasons, the principal one being that a square label can be used: this can be trimmed more neatly and quickly than a round label, and, in the opinion of many pharmacists of taste, looks better. A small quantity of dusting-powder should be placed in the box, to prevent the adhesion of freshly-made pills.

Officinal Pills.—The following formulas for pills have been adopted by the U. S. Pharmacopœia with the view of securing uniformity in their preparation:

PILULÆ ALOES. *U. S.* **Pills of Aloes.**

	Grains.	Grammes.
Purified Aloes, in fine powder, *two hundred grains*	200	13.00
Soap, in fine powder, *two hundred grains*	200	13.00
	400	26.00
To make *one hundred pills*	100	

Beat them together with water so as to form a mass, and divide it into *one hundred pills.*

PILULÆ ALOES ET ASAFŒTIDÆ. *U.S.* **Pills of Aloes and Asafetida.**

	Grains.	Grammes.
Purified Aloes, in fine powder, *four hundred grains*	400	26.00
Asafetida, *four hundred grains*	400	26.00
Soap, in fine powder, *four hundred grains*	400	26.00
	1200	78.00
To make *three hundred pills*	300	

Beat them together with water so as to form a mass, and divide it into *three hundred pills.*

PILULÆ ALOES ET FERRI. *U.S.* **Pills of Aloes and Iron.**

	Grains.	Grammes.
Purified Aloes, in fine powder, *one hundred grains*	100	6.50
Dried Sulphate of Iron, *one hundred grains*	100	6.50
Aromatic Powder, *one hundred grains*	100	6.50
Confection of Rose, *a sufficient quantity,*		
	300	19.50
To make *one hundred pills*	100	

Beat the powders together with Confection of Rose so as to form a mass, and divide it into *one hundred pills.*

PILULÆ ALOES ET MASTICHES. *U.S.* **Pills of Aloes and Mastic.**

	Grains.	Grammes.
Purified Aloes, in fine powder, *two hundred grains*	200	13.00
Mastic, in fine powder, *fifty grains*	50	3.25
Red Rose, in fine powder, *fifty grains*	50	3.25
	300	19.50
To make *one hundred pills*	100	

Beat them together with water so as to form a mass, and divide it into *one hundred pills.*

PILULÆ ALOES ET MYRRHÆ. *U.S.* **Pills of Aloes and Myrrh.**

	Grains.	Grammes.
Purified Aloes, in fine powder, *two hundred grains*	200	13.00
Myrrh, in fine powder, *one hundred grains*	100	6.50
Aromatic Powder, *fifty grains*	50	3.25
Syrup, *a sufficient quantity,*		
	350	22.75
To make *one hundred pills*	100	

Beat them together so as to form a mass, and divide it into *one hundred pills.*

PILULÆ ANTIMONII COMPOSITÆ. *U.S.* **Compound Pills of Antimony.**
[PLUMMER'S PILLS.]

	Grains.	Grammes.
Sulphurated Antimony, *fifty grains*	50	3.25
Mild Chloride of Mercury, *fifty grains*	50	3.25
Guaiac, in fine powder, *one hundred grains*	100	6.50
Mucilage of Tragacanth, *a sufficient quantity,*		
	200	13.00
To make *one hundred pills*	100	

Mix the powders, beat them together with Mucilage of Tragacanth, so as to form a mass, and divide it into *one hundred pills.*

PILULÆ ASAFŒTIDÆ. *U.S.* **Pills of Asafetida.**

	Grains.	Grammes.
Asafetida, *three hundred grains*	300	19.50
Soap, in fine powder, *one hundred grains*	100	6.50
	400	26.00
To make *one hundred pills*	100	

Beat them together with water so as to form a mass, and divide it into *one hundred pills.*

PILULÆ CATHARTICÆ COMPOSITÆ. *U.S.* **Compound Cathartic Pills.**

	Grains.	Grammes.
Compound Extract of Colocynth, *one hundred and thirty grains*	130	8.40
Abstract of Jalap, *one hundred grains*	100	6.50
Mild Chloride of Mercury, *one hundred grains*	100	6.50
Gamboge, in fine powder, *twenty-five grains*	25	1.60
	355	23.00
To make *one hundred pills*	100	

Mix the powders intimately; then with water form a mass, and divide it into *one hundred pills.*

PILULÆ FERRI COMPOSITÆ. *U.S.* **Compound Pills of Iron.**

	Grains.	Grammes.
Myrrh, in fine powder, *one hundred and fifty grains*	150	9.75
Carbonate of Sodium, *seventy-five grains*	75	4.85
Sulphate of Iron, *seventy-five grains*	75	4.85
Syrup, *a sufficient quantity,*		
	300	19.45
To make *one hundred pills*	100	

Rub the Myrrh, first with the Carbonate of Sodium, and afterwards with the Sulphate of Iron, until they are thoroughly mixed; then beat them with Syrup so as to form a mass, and divide it into *one hundred pills.*

PILULÆ FERRI IODIDI. *U.S.* **Pills of Iodide of Iron.**

	Grains.	Grammes.
Reduced Iron, *sixty grains*	60	4.00
Iodine, *eighty grains*	80	5.20
Glycyrrhiza, in No. 60 powder, *fifty grains*	50	3.25
Sugar, in fine powder, *fifty grains*	50	3.25
Extract of Glycyrrhiza, in fine powder, *twelve grains*	12	0.75
Acacia, in fine powder, *twelve grains*	12	0.75
Water,		
Balsam of Tolu,		
Stronger Ether, each, *a sufficient quantity,*		
	264	17.20
To make *one hundred pills*	100	

To the Reduced Iron, contained in a porcelain capsule, add about *one hundred and twenty grains*, or about *eight grammes*, of Water, and gradually add the Iodine, constantly triturating, until the mixture ceases to have a reddish tint. Then add the remaining powders, previously mixed, and evaporate the excess of moisture, on the water-bath, constantly stirring, until the mass has acquired a pilular consistence. Lastly, divide it into *one hundred pills*.

Dissolve *one part* of Balsam of Tolu in *one part* of Stronger Ether, shake the pills with a sufficient quantity of this solution until they are uniformly coated, and put them on a plate to dry, occasionally stirring them until the drying is completed.

Keep the pills in a well-stopped bottle.

Pills of Iodide of Iron should be devoid of the smell of Iodine, and distilled water, rubbed with them and filtered, should not impart more than a light blue tint to gelatinized starch (absence of more than traces of free iodine).

PILULÆ GALBANI COMPOSITÆ. *U.S.* **Compound Pills of Galbanum.**

	Grains.	Grammes.
Galbanum, *one hundred and fifty grains*	150	9.75
Myrrh, *one hundred and fifty grains*	150	9.75
Asafetida, *fifty grains*	50	3.25
Syrup, *a sufficient quantity,*		
	350	22.75
To make *one hundred pills*	100	

Beat them together so as to form a mass, and divide it into *one hundred pills.*

PILULÆ OPII. *U.S.* **Pills of Opium.**

	Grains.	Grammes.
Powdered Opium, *one hundred grains*	100	6.50
Soap, in fine powder, *twenty-five grains*	25	1.62
	125	8.12
To make *one hundred pills*	100	

Beat them together with water so as to form a mass, and divide it into *one hundred pills.*

PILULÆ PHOSPHORI. *U.S.* **Pills of Phosphorus.**

	Grains.	Grammes.
Phosphorus, *one grain*	1	0.06
Althæa, in No. 60 powder, *eighty grains*	80	5.20
Acacia, in fine powder, *twenty grains*	20	1.30
Glycerin, *forty grains*	40	2.60
Water, *twenty grains*	20	1.30
Purified Chloroform, *fifty grains*	50	3.20
Balsam of Tolu,		
Stronger Ether, each, *a sufficient quantity,*		
To make *one hundred pills*	100	

Dissolve the Phosphorus in the Chloroform, in a test-tube. Mix the Althæa and the Acacia, in a mortar, with the pestle, add the solution

of Phosphorus, then the Glycerin and the Water, and quickly form a mass, to be divided into *one hundred pills.*

Dissolve *one part* of Balsam of Tolu in *one part* of Stronger Ether, shake the pills with a sufficient quantity of the solution until they are uniformly coated, and put them on a plate to dry, occasionally stirring until the drying is completed.

Keep the pills in a well-stopped bottle.

PILULÆ RHEI. *U.S.* **Pills of Rhubarb.**

	Grains.	Grammes.
Rhubarb, in fine powder, *three hundred grains*	300	19.50
Soap, in fine powder, *one hundred grains*	100	6.50
	400	26.00
To make *one hundred pills*	100	

Beat them together with water so as to form a mass, and divide it into *one hundred pills.*

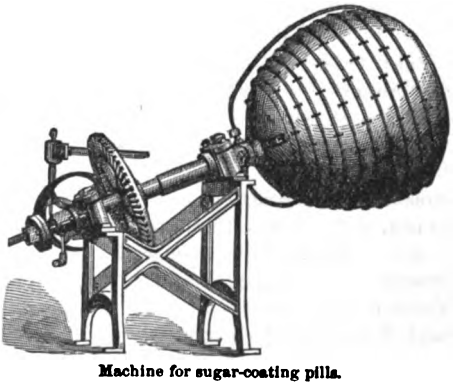
PILULÆ RHEI COMPOSITÆ. *U.S.* **Compound Pills of Rhubarb.**

	Grains.	Grammes.
Rhubarb, in No. 60 powder, *two hundred grains*	200	13.00
Purified Aloes, in fine powder, *one hundred and fifty grains*	150	9.75
Myrrh, in fine powder, *one hundred grains*	100	6.50
Oil of Peppermint, *ten grains*	10	.65
	460	29.90
To make *one hundred pills*	100	

Beat them together with water so as to form a mass, and divide it into *one hundred pills.*

Coating Pills.—Pills are coated with sugar, gelatin, silver leaf, gold leaf, or French chalk, with the view of masking their taste. The sugar-coating of pills is carried on upon a very large scale in this country. The pills are carefully dried, placed in a round-bottomed copper pan, a mixture of syrup and starch added, the whole heated, and the pan kept moving constantly, so that a rotary motion is imparted. Whilst evaporation takes place, additions of syrup are made from time to time, so that a crust of sugar gradually forms upon the surface of each pill. Fig. 434 shows the form of pill-coater used by Allaire, Woodward & Co., of Peoria, Illinois. The rotary motion and heating of the copper pan are effected by the use of steam. A polish is given to the pills by agitating them in a bag or rolling them in a shaker in contact with a piece of wax or paraffin.

FIG. 434.

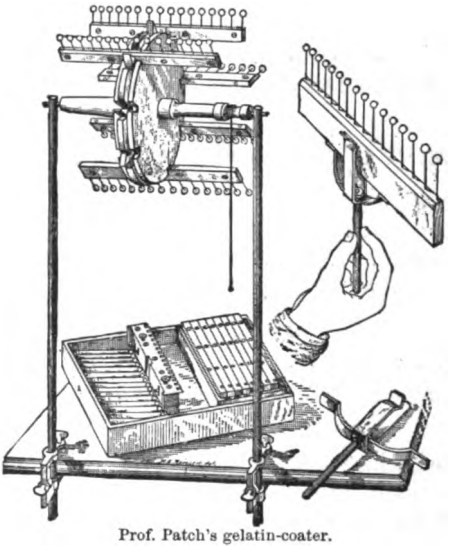


Machine for sugar-coating pills.

Pills cannot be satisfactorily coated with sugar in the small way

without much labor. This is not the case with gelatin coating. It is quite possible for the pharmacist to coat pills with gelatin and be able to dispense them in fifteen minutes. The coating of pills with gelatin is an old process. Formerly each pill was impaled upon a long needle, dipped into a solution of gelatin, and the end of the needle stuck into a cork to permit the coating to dry. This slow process was improved by Chas. B. Allaire, who devised a machine for dipping a number of pills at once, and also one for stripping the needle-bar. Since then many machines have been introduced for coating pills with gelatin.

FIG. 435.



Prof. Patch's gelatin-coater.

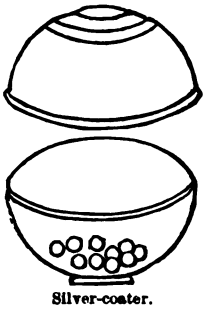
In Maynard's pill-coater the needles are arranged upon a circular plate: this is the most compact of all the coaters. Prof. Patch's coater is shown in Fig. 435. The dried pills, which must not be made with glycerin, roll down the inclined grooves, shown in the tray in the drawing, until each of the hemispherical depressions at the end of the groove contains a pill. A wooden strip armed with sixteen needles is inverted over the sixteen pills in the depressions, and the points of the needles are pressed into them until every one is impaled; the adjustable handle is now attached, and the pills are dipped into a hot solution of pure gelatin (page 978), and then gently twirled until the coating has set, when the strip is transferred to the catch in the wheel. This wheel is made to rotate, first in one direction and then in the opposite, by alternately pulling and relaxing the string attached to the axle: this rapidly dries the coating. The needles are stripped of the pills by engaging them in the comb, as shown in the cut. In Franciscus's pill-coater the needles are set in a brass bar, and the rotation is in a different direction. Other machines are favorably known: in the larger-sized Porcupine pill-coater the revolution of the cylinder to which the needle-bars are attached is effected by clock-work.

Pills are sometimes coated with gelatin by cutting the pill-cylinder, whilst soft, with a sharp knife, longitudinally to its centre and then placing in the cleft a piece of sewing-silk. The cylinder is again rolled, and the pills divided and made into an ovoid shape upon the pill-machine. They now resemble a string of beads, and are quickly dipped into a gelatin solution, and the excess of gelatin removed by rapidly twirling the string of pills: when dry, the pills are cut apart, the presence of a short piece of slender silk in each pill not being regarded as injurious to the patient who is to swallow the pill.

Pills may be coated with gold or silver leaf by first placing a drop

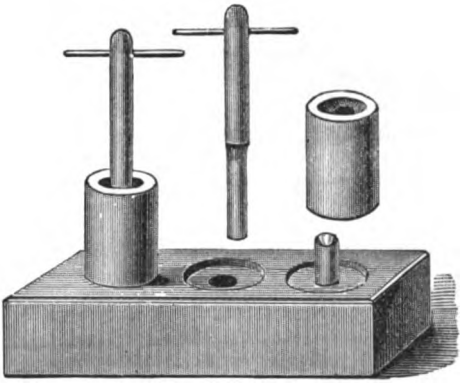
of syrup of acacia in a mortar, and, after carefully spreading it over the surface with the end of the finger, dropping in the pills, rotating them so that they shall be uniformly coated with a very thin layer of mucilage, and then dropping them into the gold or silver leaf contained in the coater. This is merely a smooth, globular box, opening in the middle (see Fig. 436). When the pills are rotated, they soon become coated with the leaf, and are then ready to dispense. In the absence of a globular box a large-sized pill-box may be used.

FIG. 436.



Silver-coater.

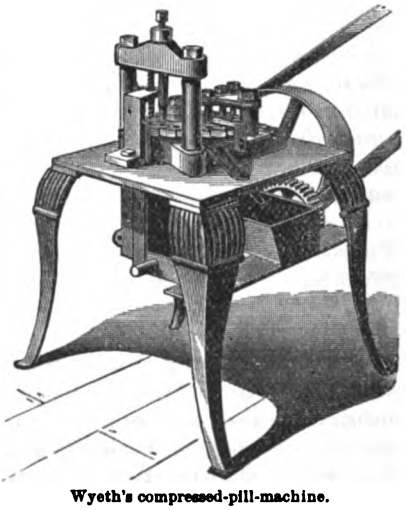
FIG. 437.



Compressed-pill-machine.

Compressed Pills and Troches are made by subjecting dry powders to a sufficient degree of pressure in suitable machines to cause them to cohere: the pressure may be effected by a blow from a mallet, or by means of a lever or combination of levers. To enable the pharmacist to prepare his own compressed pills, in 1875 the author devised the machine shown in Fig. 437 for making them. It is made of cast steel: the base has two countersunk depressions with a short post in the centre of each; a lenticular depression is made in the upper surface of each post. A steel cylinder having a central aperture of the diameter of the post is placed in the depression, the proper quantity of powder is introduced, and the plunger, which has a corresponding lenticular depression on its lower surface, is placed on the powder and is struck a quick blow with a mallet; the powder is compressed, and the pill adheres to the cylinder; by removing the cylinder and holding it over a box and tapping the plunger again lightly, the pill is forced out, and falls into a

FIG. 438.



Wyeth's compressed-pill-machine.

box. Brockedon, of England, was the first manufacturer who introduced this form of pill. In this country, Jacob Dunton, of Philadelphia, was the first to extend the process to a long line of pills, but subsequently John Wyeth & Bro. prepared compressed pills upon an enormous scale.

Fig. 438 shows one of the compressed-pill-machines in use by this firm. A circular steel disk, perforated with a number of holes, is made to revolve slowly; at regular intervals its motion is stopped long enough to deposit the proper weight of powder and to permit a plunger having a moulded end, as in Fig. 437, moving from above, almost to meet a similar one rising from below the plate; the powder is caught between the two moulds, is compressed, and the pill finds its way out through the spout into the box below. The advantages of compressed pills are that no excipient is used in their preparation, they are easily disintegrated or dissolved in the liquids of the stomach, and their lenticular shape is favorable to their being easily swallowed.

Gelatin-Coating Solution.

(Prof. Patch.)

Gelatin (French, gold label)	2½ oz. (av.).
Powdered Boric Acid	120 gr.
Mucilage of Acacia (U. S. 1880)	2 fl. oz.
Distilled Water	7 fl. oz.

Macerate the Gelatin with the Water until it softens, dissolve it by heating in a water-bath, and add the Boric Acid; then slowly add the Mucilage of Acacia, and strain the mixture.

GELATIN CAPSULES AND PEARLS.

The gelatin-coated pill is not the only form in which nauseous or bitter medicines may be administered with their taste concealed, gelatin capsules having been in use for many years.

Gelatin Capsules are of three kinds, designated as hard, soft, and empty: the first two are used in administering liquids. Empty capsules may be used for liquids, but they are generally employed in concealing the taste of bitter solids. The principle upon which they are all made is that of dipping a smooth mould, usually of bone or ivory, into a thick, hot solution of gelatin, allowing the film to become cold, removing it at the proper time, filling it with the liquid, and then sealing it.

Figs. 439, 440, 441, 442, and 443 show the apparatus used by Parke, Davis & Co., and illustrate the method of making and filling capsules. The process is not new, and the theory is simple, but success in making capsules is not apt to crown the first efforts, considerable experience being necessary.

The material employed for the shells or envelopes of soft elastic capsules is a composition of gelatin and glycerin, the proportions being varied according as a softer or a harder capsule is desired. A sufficient quantity of water is employed in making the composition to produce a fluid which shall be of the proper consistency. No exact formula can be strictly adhered to, because the proportion will vary with different samples of gelatin; but after a little experience the operator learns to adjust it to a nicety. The composition must be kept at a uniform tem-

perature—about 40° C. (104° F.)—by means of a water-bath. A wooden mould, having a stem about four inches in length (see Fig. 439), is employed for forming the shell. A number of these moulds are fixed in the perforated wooden disks shown in Fig. 442, and when in use these disks are supported on a simple frame or rack, consisting of two parallel strips of wood about four inches apart (see Fig. 441). The moulds must be slightly oiled, to prevent the composition from

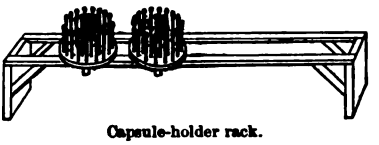
FIG. 440.

Shell-supporter.

FIG. 439.

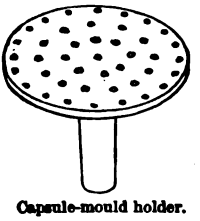
Capsule-mould.

FIG. 441.



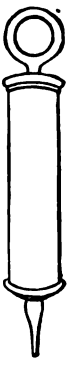
Capsule-holder rack.

FIG. 442.



Capsule-mould holder.

FIG. 443.



Capsule-syringe.

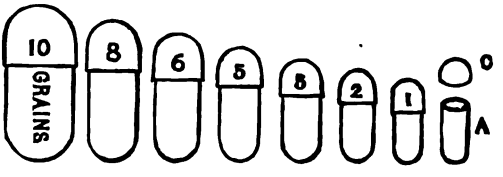
adhering to them; but excess of oil must be avoided, or they will refuse to take the gelatin. All being now in readiness, the operator takes one of the disks from the rack by its handle, inverts it, and dips the mould carefully into the gelatin composition, then withdraws it slowly with a steady motion, so as not to take up more of the fluid than is required. The moulds are now held in a current of cold air, produced by a fan or other suitable device, being kept in constant motion by the operator to secure an even distribution of the gelatin until it is sufficiently congealed, when the disk is returned to its place, and the operation is repeated with a second disk. The disks are allowed to remain a few minutes on the rack, until the gelatin is hard enough to be handled without sticking to the fingers. They are then taken to a table, and by a smart rap with the hand (the disk being held in a vertical position) the moulds are shaken out of their sockets. An operator provided with an ivory knife next separates the capsule from the superfluous gelatin which has adhered to the stem of the mould, and the soft, elastic shell is then pulled from the mould and placed in an upright position for filling upon the shell-supporter (see Fig. 440). This operation of stripping off the capsules can be best performed by the delicate fingers of a young girl, since any

roughness in the cuticle of the operator will leave its impression indelibly upon the soft gelatin.

The capsules are filled by the skilful use of the syringe (see Fig. 443), great care being taken that none of the oil be allowed to touch the edge of the capsule, since such an accident would render it impossible to seal the capsule. The final operation of sealing is accomplished by passing over the opening a small stick charged with the gelatin composition of which the capsule is made. When the capsules are thus finished, they are allowed to stand a few hours on the supporters to dry, and are then spread out on a sheet of white paper in order to detect any that may be imperfectly sealed. These having been removed, the capsules are ready to be packed in boxes for the market. The hard capsules differ from the elastic ones only in the omission of glycerin from the composition of the envelopes, the manipulation being the same, except that it is necessary to allow the finished capsules to remain several days on the supporters to become completely dry and hard before they are packed.

Empty capsules are not ovoid in shape, but cylindrical (see Fig. 444). They are made of several sizes, and are usually designated by numbers. The smallest size in the illustration is represented with the cap, C, off: these are used by pharmacists for enclosing nauseous or bitter powders or masses. They are filled in several ways: one plan is to make a mass of the powders, divide it into little rolls, as in making pills, insert them in the larger end of the capsule, A, and place the cap, C, tightly upon it. To fill the capsules with powders several devices are employed. Whitfield's capsule-filler is the most elaborate apparatus. Davenport's method is very simple: the filler is shown in Fig. 445. It consists of a funnel, tube, and plunger. The funnel is flattened at one side, to assist in taking up the material, the tube attached to the funnel is of the proper size to be placed in the capsule, and its end is cut off at an angle to permit its ready application in the capsule. The funnel and tube are made from one piece of metal, without seam or joints. The plunger is of hard wood, and of the proper size for entering the tube. It is supplied with a rubber collar, which admits of the piston's being pressed entirely through the tube to eject the material. Each filler and plunger is numbered to correspond with the number of the capsule. In use, the material is first divided into powders; the capsule is placed on the tube, the flat edge of the funnel held nearest to the operator, and the powder scraped into the funnel; the filler is held in an upright position, and the plunger raised; after the powder has

FIG. 444.



Empty capsules.

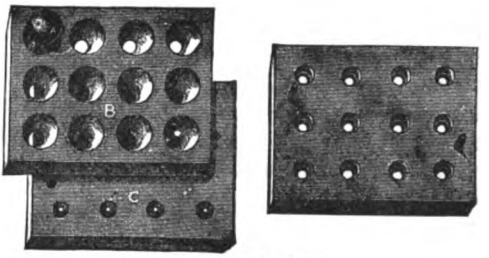
FIG. 445.

Davenport's capsule-filler.

passed into the tube, the plunger is inserted, the capsule held firmly on the tube, and pressure applied to the plunger, forcing the powder into the capsule, which is then removed and capped in the usual manner.

Reymond's capsule-filler (see Figs. 446 and 447) consists of two blocks of hard wood. In the lower one in Fig. 446, C, twelve sockets are bored of sufficient depth to enable the capsules to be inserted one-half of their length: these sockets are so shaped at the bottom as to correspond with the lower end of the capsule. A small hole is bored through the bottom of each socket. The upper side of the upper block, B, is provided with twelve funnel-shaped receptacles of sufficient capacity to hold all the powder intended to fill the capsule, the lower end of these receptacles being so shaped that when the two sections are in proper position for use they will project just over the upper edge of the capsule. The under side of this section is provided with twelve holes a trifle larger than those in C, and of sufficient length to cover that portion of the capsule projecting above C. Pegs are inserted in either section to fit into corresponding holes in the other, so as to hold the two together in proper position when the filler is in use (see Fig. 447). A tampon, A, is provided with which to pack the capsule.

FIG. 446. FIG. 447.



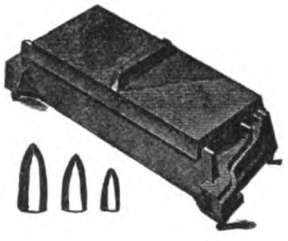
Reymond's capsule-filler.

Suppositoria. *Suppositories.*

Suppositories are solid bodies intended to be introduced into the rectum, urethra, or vagina to produce medicinal action. Their form is usually conical, with a rounded apex, and their consistence should be such that, whilst they will retain their shape at ordinary temperatures, they will readily melt or soften at the temperature of the body. Oleum theobromæ, or cacao butter, is the best base for suppositories, because it accurately fulfils both of the above requirements: it was first suggested in this connection in 1852, by Mr. Alfred B. Taylor, of Philadelphia. It is rarely necessary to raise the melting point of cacao butter by the addition of wax, spermaceti, etc., except in the warmest summer weather, or when carbolic acid, camphor, chloral, the volatile oils, or similar substances form the medicating ingredients. Gelatin suppositories are made from a mass containing gelatin and glycerin, by soaking gelatin in water, draining off the excess, adding five parts by weight of glycerin to every twelve parts of soft gelatin, and heating in a water-bath. The medicating substance is rubbed into a smooth paste with a small quantity of water or glycerin and added to the mass. Since the extended use of suppositories the size has been gradually reduced, until fifteen-grain suppositories are now most largely employed. Suppositories are usually of three kinds: 1. Rolled; 2. Moulded; 3. Pressed.

1. **Rolled Suppositories** are made by a very simple method: the cacao butter is scraped or grated and placed in a mortar; the medicating ingredients are reduced to powder, or, if composed of extracts, are softened with water and rubbed until a smooth paste is formed; a mass resembling a pill mass is now made by thoroughly incorporating the ingredients with a pestle, and, having thoroughly dusted a pill-tile with lycopodium, a suppository cylinder is formed by rolling the mass upon the tile with a spatula, after having softened it by partly shaping it with the fingers: if the mass is brittle, it may be softened by thoroughly incorporating a few drops of olive oil with it; the cylinder is rolled out and then cut into the proper number of pieces with a spatula; the conical shape is given by rolling *one end* upon the tile with a spatula, so as to produce a rounded point. In warm weather it is necessary to use lycopodium, powdered elm bark, or a similar absorbent powder freely. With practice, excellent rolled suppositories can be made. This method has the substantial merit of requiring very little apparatus, but considerable skill is needed to produce suppositories equalling in finish those which are moulded. Fig. 448 and Fig. 449 show two views of Bing's apparatus for shaping rolled suppositories. The suppository cylinder is placed upon the base-plate and well dusted with lycopodium; it will be observed that the plate has the shape of one-half of a suppository divided longitudinally; upon moving the upper plate backward and forward on the suppository cylinder, gradually increasing the pressure, the suppository assumes the conical form. Three base-plates, for three different sizes of suppositories, are shown.

FIG. 448.



Bing's suppository-machine.

FIG. 449.

End-view of the same.

2. **Moulded Suppositories** are more largely used than any other kind; preference is given to them in the officinal directions, although the other kinds are permitted: the directions are as follows:

Mix the medicinal portion (previously brought to a proper consistence, if necessary) with a small quantity of Oil of Theobroma, by rubbing them together, and add the mixture to the remainder of the Oil of Theobroma, previously melted and cooled to the temperature of 35° C. (95° F.). Then mix thoroughly, without applying more heat, and immediately pour the mixture into suitable moulds. The moulds must be kept cold by being placed on ice, or by immersion in ice-cold water; and the inner surface of the moulds should be carefully freed from adhering moisture, before the melted mass is poured in. In the absence of suitable moulds, suppositories may be formed by allowing the mixture, prepared as above, to cool, care being taken to keep the ingredients well mixed, and dividing into parts of a definite weight each, which may be made into a conical or other convenient form for a suppository. Unless otherwise specified, suppositories shall be made to weigh about fifteen grains, or one gramme.

The principle upon which suppositories are moulded depends upon the fact that the mass after being introduced into the moulds contracts upon cooling; when the limit of contraction is reached, the suppository is a trifle smaller than the mould in which it has been made, and it can be easily extracted: hence the importance of allowing the moulds to become thoroughly cold after the introduction of the melted mass. The novice almost invariably makes the mistake of opening the divided moulds too soon (before the limit of contraction is reached): the suppository sticks to the mould, and splitting ensues. The difficulties encountered in making moulded suppositories generally arise from the use of too much heat in melting the mass. A suppository mass containing an extract bears some analogy to an emulsion, with the proportions of the ingredients reversed: the fatty substance here is in great excess; the extractive matter is the substance to be uniformly suspended, whilst the water is relied upon to effect this object: this can be done by making the extract into a soft paste with the water, and gradually incorporating it with the partly-melted cacao butter by stirring.

If *strong heat is used*, the water is evaporated, the extract separates in small masses, and, like a bad emulsion, the mass is "cracked." The remedy is to pour it at once upon an ointment slab or tile, add a little water, and rub it until the original condition is regained.

Pouring the Mass.—The mass should be poured into the mould from a dipper held in the right hand, a vigorous stirring being maintained with a spatula held in the left hand immediately before the pouring begins; indeed, when heavy powders are directed, the stirring must not cease during the pouring, or the last suppositories will contain a larger proportion of the heavy powder than those which were first made. A porcelain casserole (see Fig. 450) is the best vessel to melt the mass in; and it is much better to dip it into a dish containing hot water than to use direct heat. The use of lycopodium to dust the inside of the moulds is unnecessary. If proper attention be given to cooling the moulds thoroughly, there will be no difficulty from the adhesion of the suppositories.

FIG. 450. FIG. 451. FIG. 452. FIG. 453.

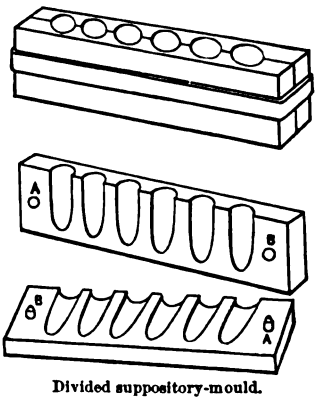
Casserole. Individual suppository-moulds.

Suppository-Moulds.—Many forms are in use. They may be arranged in three classes: 1. Individual moulds. 2. Divided moulds. 3. Hinged moulds.

1. **Individual Moulds** are those which were first employed: in this form an oval metallic dish is furnished with a lid which contains twelve circular perforations (see Fig. 452) for supporting twelve individual moulds made of white metal. To prevent the moulds from slipping through when they are placed in the perforations, they each have a shoulder, which rests upon the lid (see Fig. 451 and Fig. 453). The dish is nearly filled with chopped ice or snow, the lid supporting the moulds is placed in position, and the melted mass is

poured in. After the suppositories have become thoroughly cold, they are removed by inverting the mould and tapping it lightly on a hard surface, when they usually drop out. They sometimes fail, however, to answer the summons promptly. This is generally due to the mould's not being perfectly clean. The difficulty of quickly and easily cleaning these small moulds, and the liability of losing or misplacing them, constitute the most serious drawbacks to the use of this form.

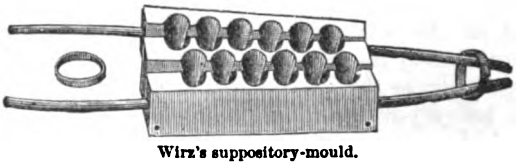
FIG. 454.



Divided suppository-mould.

Divided Moulds.—This, at present, is a favorite kind of suppository-mould, one of the advantages being the facility with which it can be cleaned. They are preferably cooled by placing them upon a piece of ice. The simplest form is shown in Fig. 454. The upper mould is represented as closed and ready for use, being held together by an ordinary rubber band. The open mould is shown below. It is made of brass, and consists of two parts, which are kept in position by placing the pins A and B in their respective sockets. This form is seen enlarged in the Wirz mould (see Fig. 455). This mould will make twelve suppositories at one time, and it is held together by two brass rings which are slipped over the handles. The circular forms have the very great advantages of requiring but a small piece of ice and of being almost indestructible. Figs. 456 and 457 show See's mould: the central core is held in position by a set-screw. Fig. 456 represents the closed mould,

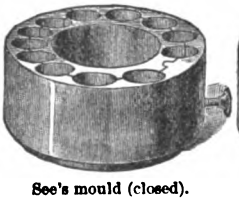
FIG. 455.



Wirz's suppository-mould.

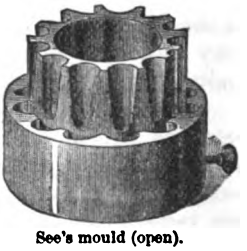
FIG. 458.

FIG. 456.

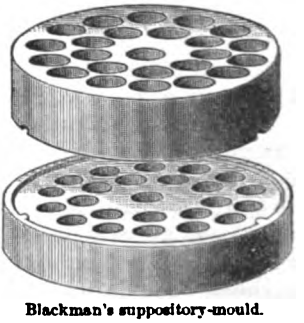


See's mould (closed).

FIG. 457.



See's mould (open).



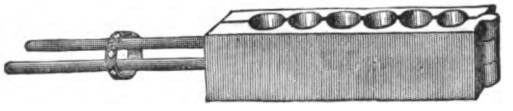
Blackman's suppository-mould.

and Fig. 457 shows the core when elevated. This mould is made by J. M. Maris & Co., of Philadelphia. The best divided mould is unquestionably that shown in Fig. 458. It is manufactured by L. R.

Blackman, of Newport, R.I. The division of this mould is horizontal instead of perpendicular. It is made of gun-metal, is nickel-plated, contains no small working parts, and is compact and simple in its construction. The relative position of the upper and lower parts is shown in the illustration. When the suppositories have contracted sufficiently to leave the mould easily, it may be known by pressing one of them slightly upon the top. If it can be moved downward slightly, it indicates that they are loose, when the upper part, carrying the suppositories, may be separated by lifting it from the lower part; it is then inverted over a piece of paper, when a light tap will cause the suppositories to drop out.

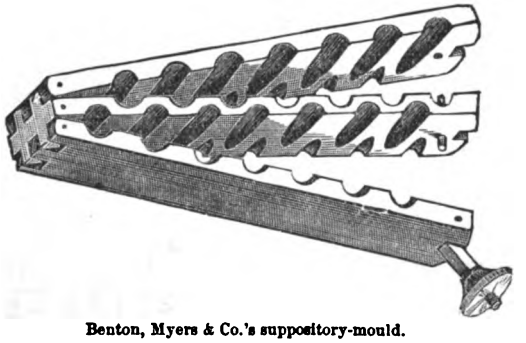
Hinged Moulds.—This form differs from the divided moulds in being connected with a hinge. They are used in the same way as the divided moulds. One of the simplest forms is seen in Fig. 459. This

FIG. 459.



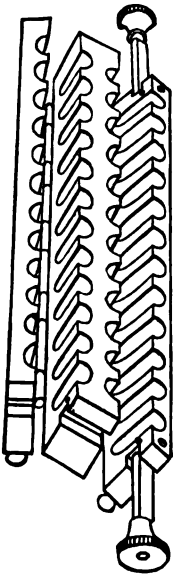
Hinged mould.

FIG. 460.



Benton, Myers & Co.'s suppository-mould.

FIG. 461.



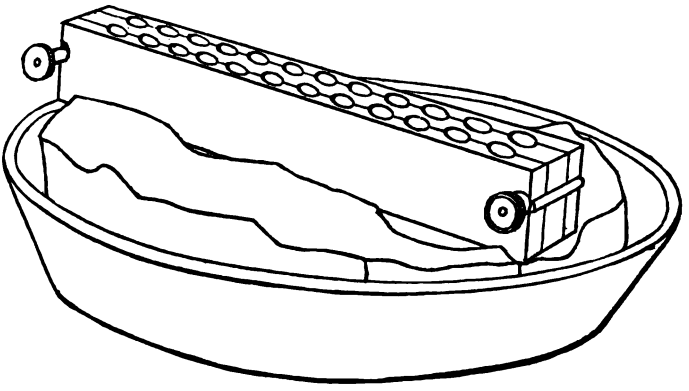
English suppository-mould.

opens perpendicularly, and is closed in the same way as the mould shown in Fig. 455. Benton, Myers & Co.'s mould (Fig. 460) is constructed so that two different sizes of suppositories may be made in it. It is in addition a double mould, is hinged at one end, and closed by a screw-catch at the other. Figs. 461 and 462 are illustrations of a very serviceable English mould, recommended by Mr. Henry B. Brady, of Newcastle-on-Tyne. It differs from all others in being hinged at the bottom. It is held together by two screw-catches, one at each end. Fig. 462 shows this mould closed, and in position upon a cake of ice.

Compressed Suppositories.—The method of making suppositories by compression has been used to some extent, but the expense of the apparatus required in their production constitutes a serious drawback.

A. M. Knowlson, of Troy, N.Y., is the maker of an effective suppository-machine, which presses the mass through a cylinder into a

Fig. 462.



Suppository-mould on ice.

mould, and finally discharges the well-finished suppository, without the use of any heat whatever. Efforts are now making to perfect a simple, effective, and cheap machine upon this principle. In Archibald's suppository-machine the compression is effected by a lever working perpendicularly in a cylinder containing the suppository mass.

Fig. 463.

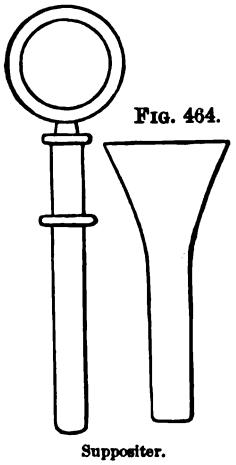
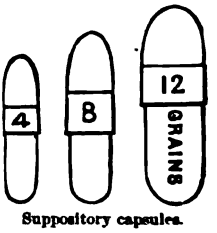


Fig. 464.

Suppositer.

Suppositories are sometimes introduced into the rectum with difficulty. Figs. 463 and 464 show a suppositer to aid in their insertion. The tube is made of hard metal, and has a funnel-shaped top (Fig. 464). The suppository is dropped into the tube, point downward, and this is carefully inserted into the rectum. The piston (Fig. 463) is now applied to the end of the suppository, which is gently pushed into the rectum, the tube being then withdrawn.

Fig. 465.



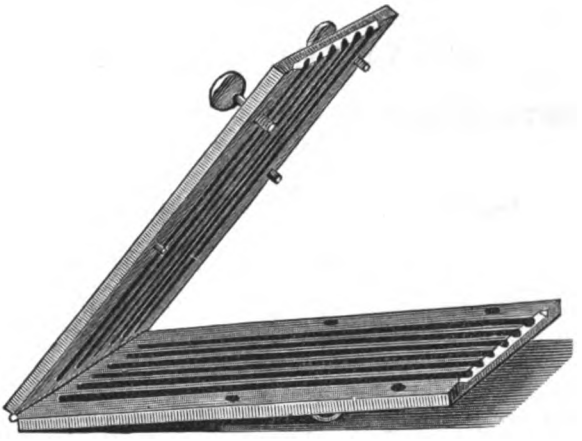
Suppository capsules.

Suppository Capsules.—Dr. F. E. Stewart has suggested the employment of gelatin shells with conical caps, to be used as suppositories. The medicating ingredients are inserted in the lower portion; the upper margin is then moistened with water, and the cap inserted. Before introducing them into the rectum they should be wet with sufficient water to enable them to slip easily (see Fig. 465).

Urethral Suppositories, or Bougies, are preferably made of gelatin, owing to the difficulty of introducing into the urethra those made from cacao butter, on account of their brittleness. They may be made by

melting together three parts of white gelatin, one part of glycerin, and one part of distilled water, by weight, then adding the desired medicament and drawing the mass into a glass tube of suitable size, which has been

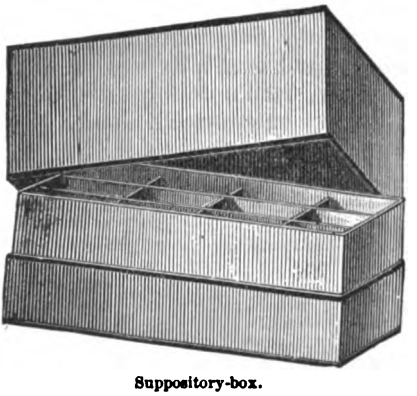
FIG. 466.



Mitchell's gelatin-bougie mould.

previously oiled by sucking a small quantity of oil into it and allowing it to run out. After cooling, the mass is pushed out by means of an oiled rod, and cut into pieces of suitable length. These should be rolled in lycopodium to prevent adhesion. Fig. 466 shows Mitchell's bougie-mould for making them in quantity.

FIG. 467.



Suppository-box.

Dispensing Suppositories.— In order to prevent injury to the surface of suppositories in handling them with warm fingers, it is advisable to place the finger-tips for a few moments upon the ice until they are chilled, before placing the suppositories in the box. The latter is preferably furnished with partitions, as made by the Randolph Paper-Box Company, of Richmond, Va. (see Fig. 467). In the absence of this special box, the suppositories should be protected by a layer of cotton.

CHAPTER LXVII.

SOLID EXTEMPORANEOUS PREPARATIONS USED EXTERNALLY.

Cerates, Ointments, Plasters, and Papers.

Cerata. *Cerates.*

Cerates are unctuous substances of such consistence that they may be easily spread, at ordinary temperatures, upon muslin or similar material with a spatula, and yet not so soft as to liquefy and run when applied to the skin. They are mostly used as dressings for inflamed surfaces, and are generally made with oil, lard, or petrolatum for a basis, with sufficient wax to give the desired consistence. Owing to the presence of wax (*Cera*), they are called *Cerates*. Paraffin, spermaceti, and resin are also used to raise the melting points of oils and fats.

Cerates are made either by *fusion* or by *incorporation*. In the first method, the ingredients are melted together, and the mixture strained, to separate mechanical impurities, and stirred until cold, to render it homogeneous. By incorporation is meant the process which consists in placing the fatty ingredients upon an ointment-slab or pill-tile, or in a mortar, and gradually mixing in the other ingredients, with a spatula or pestle, until a uniform preparation results.

Eight cerates are officinal.

Officinal Cerates made by Fusion.

Ceratum.	Made by fusing together 30 parts of white wax and 70 parts of lard, and stirring until cold.
Ceratum Cantharidis.	Made by fusing together 20 parts of yellow wax, 20 parts of resin, and 25 parts of lard, straining, adding 35 parts of cantharides, digesting for half an hour, and stirring until cold.
Ceratum Cetacei.	Made by fusing together 10 parts of spermaceti, 35 parts of white wax, and 55 parts of olive oil, and stirring until cold.
Ceratum Extracti Cantharidis.	Made by fusing together 15 parts of resin, 35 parts of yellow wax, and 35 parts of lard, digesting with 15 parts of extract of cantharides, straining, and stirring.
Ceratum Resinæ.	Made by fusing together 35 parts of resin, 15 parts of yellow wax, and 50 parts of lard, straining, and cooling.
Ceratum Sabinæ.	Made by fusing 90 parts of resin cerate, adding 25 parts of fluid extract of savine, heating, to evaporate alcohol, and stirring until cool.

Officinal Cerates made by Incorporation.

Ceratum Camphoræ.	Made by mixing 3 parts of camphor liniment with 12 parts of olive oil, and incorporating the mixture with 85 parts of cerate.
Ceratum Plumbi Subacetatis.	Made by incorporating 20 parts of solution of subacetate of lead with 80 parts of camphor cerate.

OFFICINAL PROCESSES FOR CERATES.

CERATUM. *U. S.* Cerate.

	Definite formula.
White Wax, 30 parts, or	3 oz. av.
Lard, 70 parts, or	7 oz. av.
To make 100 parts, or	10 oz. av.

Melt them together, and stir the mixture constantly until cool.

CERATUM CAMPHORÆ. *U. S.* Camphor Cerate.

	Definite formula.
Camphor Liniment, 3 parts, or	15 minims.
Olive Oil, 12 parts, or	1 fl. dr.
Cerate, 85 parts, or	400 grains.
To make 100 parts, or . . . about	1 oz.

Mix the Camphor Liniment and the Olive Oil, and incorporate with the Cerate.

CERATUM CANTHARIDIS. *U. S.* Cantharides Cerate.

[Blistering Cerate.]

	Definite formula.
Cantharides, in No. 60 powder, 35 parts, or	7 oz. av.
Yellow Wax, 20 parts, or	4 oz. av.
Resin, 20 parts, or	4 oz. av.
Lard, 25 parts, or	5 oz. av.
To make 100 parts, or	20 oz. av.

To the Wax, Resin, and Lard, previously melted together and strained through muslin, add the Cantharides, and, by means of a water-bath, keep the mixture in a liquid state for half an hour, stirring occasionally. Then remove it from the water-bath, and stir constantly until cool.

CERATUM CETACEI. *U. S.* Spermaceti Cerate.

	Definite formula.
Spermaceti, 10 parts, or	1 oz. av.
White Wax, 35 parts, or	3½ oz. av.
Olive Oil, 55 parts, or	5½ oz. av.
To make 100 parts, or	10 oz. av.

Melt together the Spermaceti and Wax; then add the Olive Oil, previously heated, and stir the mixture constantly until cool.

CERATUM EXTRACTI CANTHARIDIS. *U. S.* Cerate of Extract of Cantharides.

	By measure.
Cantharides, in No. 60 powder, 30 parts, or	6 oz. av.
Resin, 15 parts, or	3 oz. av.
Yellow Wax, 35 parts, or	7 oz. av.
Lard, 35 parts, or	7 oz. av.
Alcohol, a sufficient quantity.	

Moisten the Cantharides with *eighteen parts* [or 4 fl. oz.] of Alcohol, and pack firmly in a cylindrical percolator; then gradually pour on Alcohol, until *one hundred and eighty parts* [or 2¼ pints] of percolate

are obtained, or until the Cantharides are exhausted. Distil off the Alcohol by means of a water-bath, transfer the residue to a tared capsule and evaporate it, on a water-bath, until it weighs *fifteen parts* [or 3 oz. av.]. Add to this the Resin, Wax, and Lard, previously melted together, and keep the whole at a temperature of 100° C. (212° F.) for fifteen minutes. Lastly, strain the mixture through muslin, and stir it constantly until cool.

CERATUM PLUMBI SUBACETATIS. *U. S.* **Cerate of Subacetate of Lead.** [GOULARD'S CERATE.]

	By measure.
Solution of Subacetate of Lead, 20 parts, or	1 oz. av.
Camphor Cerate, 80 parts, or	4 oz. av.
To make 100 parts, or	5 oz. av.

Mix them thoroughly.

This Cerate should be freshly prepared, when wanted for use.

CERATUM RESINÆ. *U. S.* **Resin Cerate.** [BASILICON OINTMENT.]

	By measure.
Resin, 35 parts, or	7 oz. av.
Yellow Wax, 15 parts, or	3 oz. av.
Lard, 50 parts, or	10 oz. av.
To make 100 parts, or	20 oz. av.

Melt them together at a moderate heat, strain the mixture through muslin, and allow it to cool without stirring.

CERATUM SABINÆ. *U. S.* **Savine Cerate.**

	By measure.
Fluid Extract of Savine, 25 parts, or	5 oz. av.
Resin Cerate, 90 parts, or	18 oz. av.

Melt the Resin Cerate by means of a water-bath, add the Fluid Extract of Savine, and continue the heat until the alcohol has evaporated; then remove the heat, and stir constantly until cool.

Unguenta. *Ointments.*

Ointments are fatty preparations, of a softer consistence than cerates, intended to be applied to the skin by inunction. The medicating ingredients are combined with a basis of lard, petrolatum, or similar substance. Ointments are made in several ways: 1. By fusion. 2. By incorporation. 3. By chemical reaction.

1. **By Fusion.**—In making ointments in this way, care must be observed not to apply sufficient heat to burn the constituents. Cerates and ointments may be strained through flannel or muslin to separate mechanical impurities, and, if desired, some of them can be filtered through paper. (See Hot Filtration.)

2. **By Incorporation.**—The method of making ointments by incorporation is more frequently used than any other. The medicating ingredients used are nearly always insoluble in the basis, and it is necessary, therefore, to reduce them to a fine state of division in order to facilitate their absorption or medicinal action. The usual mode of procedure is

to place the fatty basis upon an ointment-slab, and the medicating substance close by. The latter, if in fine powder, is first mixed with a *small portion* of the basis by rubbing both backward and forward with the blade of a spatula until the mixture is perfectly smooth. It is then a very simple operation to dilute this small quantity of concentrated ointment by incorporating it with the rest of the basis, by using the spatula in the same way. If extracts are to be incorporated, they are softened by adding a little water or diluted alcohol, until a smooth paste is made, which is then mixed with the basis with a spatula. An excellent ointment-slab is made by setting a plate of ground glass in a wooden frame or slide (see page 902). Ointments are sometimes made in a mortar with the pestle; but this mode is less convenient. Lard should be benzoinated or otherwise protected from rancidity.

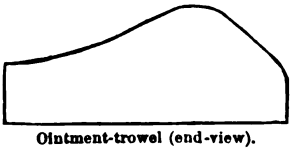
In incorporating ointments containing substances which act on steel or iron, horn spatulas may be used. These may either be a single

FIG. 468.

Spatula (all horn).

blade of horn cut into a suitable shape, or provided with a handle, as shown in Fig. 468. When large quantities of ointments are required to be made by incorporation, as is sometimes the case in hospitals, dispensaries, etc., an ointment-trowel may be made by cutting a mason's trowel into the shape shown in Figs. 469 and 470,—the former giving the end-view, the latter the side-view. This affords a large working surface, and the incorporation can be performed quickly.

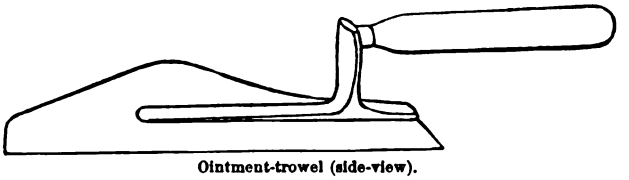
FIG. 469.



Ointment-trowel (end-view).

3. **By Chemical Reaction.**—The only officinal ointment that is made by chemical reaction is the ointment of nitrate of mercury. In

FIG. 470.



Ointment-trowel (side-view).

this, the olein of the oil is converted into elaidin through the action of heat and nitric acid; solution of mercuric nitrate is then incorporated with the elaidin base.

Maxims to be observed in making or dispensing Ointments.—1. They should never be dispensed if they have the slightest taint of rancidity. 2. They should always be smooth and free from grittiness or irritating particles. 3. Ointments containing free acid, iodine, or tannin should not be rubbed with an iron or steel spatula, on account of the chemical action on the metal.

Officinal Ointments made by Fusion.

Unguentum.	Made by fusing together 80 parts of lard and 20 parts of yellow wax.
Unguentum Aquæ Rosæ.	Made by fusing together at a moderate heat 50 parts of expressed oil of almond, 10 parts of spermaceti, and 10 parts of white wax, gradually adding 30 parts of rose water, and stirring until a uniformly soft and creamy mixture is obtained.
Unguentum Diachylon.	Made by fusing together 60 parts of lead plaster with 39 parts of olive oil, allowing the mass to become cool, and then adding 1 part of oil of lavender, stirring constantly until cold.
Unguentum Mezerei.	Made by fusing together at a moderate heat 80 parts of lard and 12 parts of yellow wax, then adding 25 parts of fluid extract of mezereum, and stirring constantly until the alcohol has evaporated.
Unguentum Picis Liquidæ.	Made by fusing at a moderate heat 50 parts of suet, then adding the tar, straining, and stirring constantly until cool.

Officinal Ointments made by Incorporation.

Unguentum Acidi Carbolici.	Made by incorporating thoroughly 10 parts of carbolic acid with 90 parts of ointment.
Unguentum Acidi Gallici.	Made by incorporating thoroughly 10 parts of gallic acid with 90 parts of benzoinated lard, avoiding the use of an iron spatula.
Unguentum Acidi Tannici.	Made by incorporating thoroughly 10 parts of tannic acid with 90 parts of benzoinated lard, avoiding the use of an iron spatula.
Unguentum Belladonnæ.	Made by rubbing 10 parts of alcoholic extract of belladonna with 6 parts of alcohol until soft, then incorporating the mixture thoroughly with 84 parts of benzoinated lard.
Unguentum Chrysarobini.	Made by incorporating thoroughly 10 parts of chrysarobin with 90 parts of benzoinated lard.
Unguentum Gallæ.	Made by incorporating thoroughly 10 parts of powdered nutgall with 90 parts of benzoinated lard.
Unguentum Hydrargyri.	Made by mixing 45 parts of mercury with 4 parts of compound tincture of benzoin, incorporating thoroughly with 10 parts of mercurial ointment, then adding 22 parts of lard and 22 parts of suet, previously melted together and partially cooled, continuing the trituration until globules of mercury cease to be visible under a magnifying power of 10 diameters.
Unguentum Hydrargyri Ammoniati.	Made by incorporating thoroughly 10 parts of ammoniated mercury with 90 parts of benzoinated lard.
Unguentum Hydrargyri Oxidi Flavi.	Made by incorporating thoroughly 10 parts of yellow oxide of mercury with 90 parts of ointment.
Unguentum Hydrargyri Oxidi Rubri.	Made by rubbing 10 parts of red oxide of mercury with a little ointment, then adding sufficient ointment to make 100 parts.
Unguentum Iodi.	Made by rubbing 4 parts of iodine and 1 part of iodide of potassium with 2 parts of water, and incorporating the mixture thoroughly with 93 parts of benzoinated lard.
Unguentum Iodoformi.	Made by incorporating thoroughly 10 parts of iodoform with 90 parts of benzoinated lard.
Unguentum Plumbi Carbonatis.	Made by incorporating thoroughly 10 parts of carbonate of lead with 90 parts of benzoinated lard.
Unguentum Plumbi Iodidi.	Made by incorporating thoroughly 10 parts of iodide of lead with 90 parts of benzoinated lard.
Unguentum Potassii Iodidi.	Made by dissolving 12 parts of iodide of potassium and 1 part of hyposulphite of sodium in 6 parts of boiling water, in a warm mortar, then incorporating the mixture thoroughly with 81 parts of benzoinated lard.
Unguentum Stramonii.	Made by rubbing 10 parts of extract of stramonium with 5 parts of water until soft, then incorporating the mixture thoroughly with 85 parts of benzoinated lard.
Unguentum Sulphuris.	Made by incorporating thoroughly 30 parts of sublimed sulphur with 70 parts of benzoinated lard.
Unguentum Sulphuris Alkalinum.	Made by rubbing 20 parts of washed sulphur with 10 parts of carbonate of potassium and 5 parts of water, then incorporating thoroughly the mixture with 65 parts of benzoinated lard.
Unguentum Veratrinæ.	Made by rubbing 4 parts of veratrine with 6 parts of alcohol, and incorporating thoroughly with 96 parts of benzoinated lard.
Unguentum Zinci Oxidi.	Made by rubbing 20 parts of oxide of zinc with 20 parts of melted benzoinated lard, then incorporating the mixture thoroughly with sufficient benzoinated lard to make 100 parts.

Officinal Ointment made by Chemical Reaction.

Unguentum Hydrargyri Nitratis.	See page 995.

UNGUENTUM. *U. S.* **Ointment.**

	Definite formula.
Lard, 80 parts, or	4 oz. av.
Yellow Wax, 20 parts, or	1 oz. av.
To make 100 parts, or	5 oz. av.

Melt the Wax and add the Lard gradually; then stir the mixture constantly until cool.

UNGUENTUM ACIDI CARBOLICI. *U. S.* **Ointment of Carbolic Acid.**

	Definite formula.
Carbolic Acid, 10 parts, or	48 grains.
Ointment, 90 parts, or	1 oz. av.
To make 100 parts, or about	1 oz.

Mix them thoroughly.

UNGUENTUM ACIDI GALLICI. *U. S.* **Ointment of Gallic Acid.**

	Definite formula.
Gallic Acid, 10 parts, or	48 grains.
Benzoinated Lard, 90 parts, or	1 oz. av.
To make 100 parts, or about	1 oz. av.

Rub the Gallic Acid with the Benzoinated Lard, gradually added, until they are thoroughly mixed, avoiding the use of an iron spatula.

UNGUENTUM ACIDI TANNICI. *U. S.* **Ointment of Tannic Acid.**

	Definite formula.
Tannic Acid, 10 parts, or	48 grains.
Benzoinated Lard, 90 parts, or	1 oz. av.
To make 100 parts, or about	1 oz.

Rub the Tannic Acid with the Benzoinated Lard, gradually added, until they are thoroughly mixed, avoiding the use of an iron spatula.

UNGUENTUM AQUÆ ROSÆ. *U. S.* **Ointment of Rose Water.**

[Cold Cream.]

	Definite formula.
Expressed Oil of Almond, 50 parts, or	5 oz. av.
Spermaceti, 10 parts, or	1 oz. av.
White Wax, 10 parts, or	1 oz. av.
Rose Water, 30 parts, or	3 fl. oz.
To make 100 parts, or	10 oz. av.

Melt together, at a moderate heat, the Oil, Spermaceti, and Wax; then gradually add the Rose Water, stirring the mixture briskly and constantly until it is cool, and continue the stirring until it has become uniformly soft and creamy.

UNGUENTUM BELLADONNÆ. *U. S.* **Belladonna Ointment.**

	Definite formula.
Alcoholic Extract of Belladonna, 10 parts, or	48 grains.
Diluted Alcohol, 6 parts, or	½ fl. dr.
Benzoinated Lard, 84 parts, or	400 grains.
To make 100 parts, or about	1 oz.

Rub the Extract with the Diluted Alcohol, until uniformly soft, then gradually add the Lard, and mix thoroughly.

UNGUENTUM CHRYSAROBINI. *U.S.* Chrysarobin Ointment.

	Definite formula.
Chrysarobin, 10 parts, or	48 grains.
Benzoinated Lard, 90 parts, or	1 oz.
To make 100 parts, or about	1 oz.

Rub the Chrysarobin with the Benzoinated Lard, gradually added, until they are thoroughly mixed.

UNGUENTUM DIACHYLON. *U.S.* Diachylon Ointment.

	Definite formula.
Lead Plaster, 60 parts, or	264 grains.
Olive Oil, 39 parts, or	170 grains.
Oil of Lavender, 1 part, or	5 minims.
To make 100 parts, or about	1 oz.

Melt together the Lead Plaster and Olive Oil, at a moderate heat; then, having permitted the mass to become partly cool, incorporate with it the Oil of Lavender, and stir constantly until cold.

UNGUENTUM GALLÆ. *U.S.* Nutgall Ointment.

	Definite formula.
Nutgall, in No. 80 powder, 10 parts, or	48 grains.
Benzoinated Lard, 90 parts, or	1 oz. av.
To make 100 parts, or about	1 oz.

Rub the Nutgall with the Benzoinated Lard, gradually added, until they are thoroughly mixed.

UNGUENTUM HYDRARGYRI. *U.S.* Mercurial Ointment.

[Blue Ointment.]

	Definite formula.
Mercury, 450 parts, or	1 oz. av.
Lard, 225 parts, or	½ oz. av.
Suet, 225 parts, or	½ oz. av.
Compound Tincture of Benzoin, 40 parts, or	40 minims.
Mercurial Ointment, 100 parts, or	100 grains.
To make 1000 parts, or about	2 oz. av.

Mix the Mercury with the Tincture of Benzoin in a mortar, add the Mercurial Ointment (which should contain 50 per cent. of mercury) and triturate the mixture until globules of Mercury cease to be visible; then add the Lard and Suet, previously melted together and partially cooled, and continue the trituration until globules of Mercury cease to be visible under a magnifying power of ten diameters.

UNGUENTUM HYDRARGYRI AMMONIATI. *U.S.* Ointment of Ammoniated Mercury.

	Definite formula.
Ammoniated Mercury, in very fine powder, 10 parts, or	48 grains.
Benzoinated Lard, 90 parts, or	1 oz. av.
To make 100 parts, or about	1 oz.

Rub the Ammoniated Mercury with the Benzoinated Lard, gradually added, until they are thoroughly mixed.

UNGUENTUM HYDRARGYRI NITRATIS. *U.S.* **Ointment of Nitrate of Mercury.** [CITRINE OINTMENT.]

	Definite formula.
Mercury, 7 parts, or	444 grains.
Nitric Acid, 17 parts, or	1 fl. oz. 5 fl. dr.
Lard Oil, 76 parts, or	11 oz. av.

Heat the Lard Oil, in a glass or porcelain vessel, to a temperature of 70° C. (158° F.); then add, without stirring, *seven parts* [or 5 fl. dr.] of Nitric Acid, continue the heat so long as a moderate effervescence continues, and allow the mixture to cool. Dissolve the Mercury in the remainder of the Nitric Acid, with the aid of sufficient heat to prevent the solution from crystallizing, add this solution to the mixture before it has become entirely cold, and mix them thoroughly, avoiding the use of an iron spatula.

UNGUENTUM HYDRARGYRI OXIDI FLAVI. *U.S.* **Ointment of Yellow Oxide of Mercury.**

	Definite formula.
Yellow Oxide of Mercury, in very fine powder, 10 parts, or	48 grains.
Ointment, 90 parts, or	1 oz. av.
To make 100 parts, or about	1 oz.

Rub the Oxide of Mercury with the Ointment, gradually added, until they are thoroughly mixed.

UNGUENTUM HYDRARGYRI OXIDI RUBRI. *U.S.* **Ointment of Red Oxide of Mercury.**

	Definite formula.
Red Oxide of Mercury, in very fine powder, 10 parts, or	48 grains.
Ointment, 90 parts, or	1 oz. av.
To make 100 parts, or about	1 oz.

Rub the Oxide of Mercury with a small quantity of the Ointment, until a perfectly smooth mixture is obtained; then gradually add the remainder of the Ointment, and mix thoroughly.

UNGUENTUM IODI. *U.S.* **Iodine Ointment.** [UNGUENTUM IODINII, Pharm. 1870.]

	Definite formula.
Iodine, 4 parts, or	18 grains.
Iodide of Potassium, 1 part, or	4 grains.
Water, 2 parts, or	8 minims.
Benzoinated Lard, 93 parts, or	420 grains.
To make 100 parts, or about	1 oz.

Rub the Iodine and Iodide of Potassium, first with the Water and then with the Benzoinated Lard, gradually added, until they are thoroughly mixed, avoiding the use of an iron spatula.

UNGUENTUM IODOFORMI. *U.S.* **Iodoform Ointment.**

	Definite formula.
Iodoform, in very fine powder, 10 parts, or	48 grains.
Benzoinated Lard, 90 parts, or	1 oz. av.
To make 100 parts, or about	1 oz.

Rub the Iodoform with the Benzoinated Lard, gradually added, until they are thoroughly mixed.

UNGUENTUM MEZEREI. *U.S.* Mezereum Ointment.

	Definite formula.
Fluid Extract of Mezereum, 25 parts, or	2 fl. dr.
Lard, 80 parts, or	360 grains.
Yellow Wax, 12 parts, or	54 grains.
To make about	1 oz. av.

Melt together the Lard and Wax with a moderate heat, add the Fluid Extract, and stir the mixture constantly until the alcohol has evaporated; then continue to stir until cool.

UNGUENTUM PICIS LIQUIDÆ. *U.S.* Tar Ointment.

	Definite formula.
Tar, 50 parts, or	½ oz. av.
Suet, 50 parts, or	½ oz. av.
To make 100 parts, or	1 oz. av.

Mix the Tar with the Suet, previously melted with a moderate heat, and, having strained the mixture through muslin, stir it constantly until cool.

UNGUENTUM PLUMBI CARBONATIS. *U.S.* Ointment of Carbonate of Lead.

	Definite formula.
Carbonate of Lead, in very fine powder, 10 parts, or	48 grains.
Benzoinated Lard, 90 parts, or	1 oz. av.
To make 100 parts, or about	1 oz.

Rub the Carbonate of Lead with the Benzoinated Lard, gradually added, until they are thoroughly mixed.

UNGUENTUM PLUMBI IODIDI. *U.S.* Ointment of Iodide of Lead.

	Definite formula.
Iodide of Lead, in very fine powder, 10 parts, or	48 grains.
Benzoinated Lard, 90 parts, or	1 oz. av.
To make 100 parts, or about	1 oz.

Rub the Iodide of Lead with the Benzoinated Lard, gradually added, until they are thoroughly mixed.

UNGUENTUM POTASSII IODIDI. *U.S.* Ointment of Iodide of Potassium.

	Definite formula.
Iodide of Potassium, in fine powder, 12 parts, or	60 grains.
Hyposulphite of Sodium, 1 part, or	5 grains.
Boiling Water, 6 parts, or	½ fl. dr.
Benzoinated Lard, 81 parts, or	400 grains.
To make 100 parts, or about	1 oz.

Dissolve the Iodide of Potassium and the Hyposulphite of Sodium in the Boiling Water, in a warm mortar; then gradually add the Benzoinated Lard, and mix thoroughly.

UNGUENTUM STRAMONII. *U. S.* **Stramonium Ointment.**

	Definite formula.
Extract of Stramonium, 10 parts, or	48 grains.
Water, 5 parts, or	½ fl. dr.
Benzoinated Lard, 85 parts, or	400 grains.
To make 100 parts, or about	1 oz.

Rub the Extract with the Water until uniformly soft; then gradually add the Benzoinated Lard, and mix thoroughly.

UNGUENTUM SULPHURIS. *U. S.* **Sulphur Ointment.**

	Definite formula.
Sublimed Sulphur, 30 parts, or	130 grains.
Benzoinated Lard, 70 parts, or	300 grains.
To make 100 parts, or about	1 oz.

Rub the Sulphur with the Benzoinated Lard, gradually added, until they are thoroughly mixed.

UNGUENTUM SULPHURIS ALKALINUM. *U. S.* **Alkaline Sulphur Ointment.**

	Definite formula.
Washed Sulphur, 20 parts, or	96 grains.
Carbonate of Potassium, 10 parts, or	48 grains.
Water, 5 parts, or	½ fl. dr.
Benzoinated Lard, 65 parts, or	312 grains.
To make 100 parts, or about	1 oz.

Rub the Sulphur with the Carbonate of Potassium and the Water, gradually add the Benzoinated Lard, and mix thoroughly.

UNGUENTUM VERATRINÆ. *U. S.* **Veratrine Ointment.**

[UNGUENTUM VERATRIÆ, Pharm. 1870.]

	Definite formula.
Veratrine, 4 parts, or	18 grains.
Alcohol, 6 parts, or	½ fl. dr.
Benzoinated Lard, 96 parts, or	432 grains.

Rub the Veratrine with the Alcohol, in a warm mortar, until dissolved; then gradually add the Benzoinated Lard, and mix thoroughly.

UNGUENTUM ZINCI OXIDI. *U. S.* **Ointment of Oxide of Zinc.**

	Definite formula.
Oxide of Zinc, 20 parts, or	90 grains.
Benzoinated Lard, 80 parts, or	360 grains.
To make 100 parts, or about	1 oz.

Rub the Oxide of Zinc with *twenty parts* [or 90 gr.] of Benzoinated Lard, previously melted, until the mixture is perfectly smooth; then add the remainder of the Benzoinated Lard, and mix thoroughly.

Preserving and Dispensing Cerates and Ointments.—As has been already stated, fatty substances may be preserved from rancidity by digesting them with balsamic resins, poplar buds, styrax, etc. To preserve them during hot weather, they require in addition a cool temperature

and freedom from exposure to the air (see page 906). When a fresh lot of ointment is made to replenish a stock jar, the jar should be thoroughly cleaned, and the old ointment remaining thrown away, unless it is certain that the latter is entirely free from rancidity, as otherwise it would soon cause the new ointment to become rancid. Amber glass, stoneware, or porcelain jars are the best receptacles for ointments. Queen's-ware or china jars soon permit the fatty substance to penetrate through the minute fissures which are always present. Fig. 471 shows a German porcelain jar, which is just as useful for preserving ointments as it is for holding a penetrating substance like green soap. Fig. 472 illustrates an amber glass stock ointment-jar made by Whitall, Tatum & Co. The letters for the label are blown in the glass, and then ground off, so that the label is indestructible. The only difficulty is that the label requires a strong light to enable it to be seen clearly. For dispensing ointments the opal glass jar is very useful. One of the best shapes is shown in Fig. 473. The bottom is rounded, so that the patient can easily reach all the ointment with the finger, and the top is metallic, with a screw-cap. There is room for the label on the glass. The jar shown in Fig. 474 is not recommended. The bottom forms an angle with the sides which collects the ointment, the shoulder also catches a portion, whilst the wooden top is very apt to shrink, so that there is difficulty in getting it off without breaking it. The glass box shown in Fig. 475 has a wooden top with a lithographed label. These are certainly the handsomest ointment-boxes and the most expensive. The lids will often contract, however, and give trouble in getting them on and off. Collapsible tubes, made by A. H. Wirz & Co., of Philadelphia, are used in dispensing soft ointments. If the latter contain no acid or corrosive

Fig. 471.

Porcelain jar.

Fig. 472.

Ointment-jar (amber glass).

Fig. 473.

Jar for dispensing ointments.

Fig. 474.

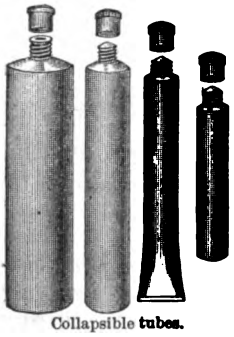
Ointment-jar, wooden top.

Fig. 475.

German ointment-jar.

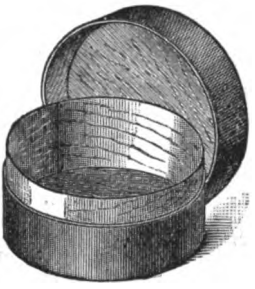
constituents they answer an admirable purpose as containers for them (see Fig. 476). These soft metal tubes are filled from the bottom with the ointment melted with just sufficient heat to permit it to be poured, and then closed by folding the ends together, as shown in one of them, and rolling the fold over twice with a pair of pliers. A screw-cap is placed upon the top, and the ointment is perfectly protected from exposure. To obtain a little, the screw-cap is taken off, and the bottom of the tube slightly pressed between the thumb and finger, when a portion of the ointment quickly exudes. Of the very cheap boxes, those turned from wood are totally *unfit* for dispensing ointments. The ointment quickly penetrates through the grain of the wooden bottom, and the greasy abomination is exceedingly unwelcome to most housekeepers. A chip-wood box covered with pasteboard is preferable, because it offers more resistance to the passage of the fatty substance (see Fig. 477). The impervious walnut boxes, made by gluing several veneers of hard wood together, are still better.

FIG. 476.



Collapsible tubes.

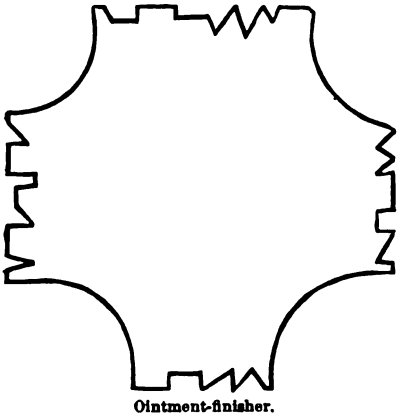
FIG. 477.



Paper-covered chip box.

Finishing Ointments.—Some skill is required to fill a box with ointment neatly and deftly by using a spatula without soiling the exterior of the box. The surface is generally scraped with the edge of the spatula to give it a smooth finish, and this is sometimes held near a hot surface, like a stove-plate, to give it a gloss. Occasionally it will be found that some nervous patients desire to be assured that an ointment or cerate has not been tampered with by a servant, and it may be desirable for other reasons to finish the surface of an ointment with a distinctive design. This may be done by cutting a piece of tin into a shape similar to that shown in Fig. 478. By placing one of the teeth on the edge of the jar (see Fig. 479),

FIG. 478.



Ointment-finisher.

FIG. 479.

Finishing ointments.

and slowly rotating it, with alternate pauses, a very neat finish may be given to the surface. The finisher (see Fig. 478) shows four sides, and is of course capable of making four patterns.

Emplastra. *Plasters.*

Plasters are substances intended for external application, of such consistence that they adhere to the skin, and require the aid of heat in spreading them. The word plaster is applied not only to the solid substance which is used to spread upon the muslin, leather, paper, or other material which serves to hold it, but to the spread plaster itself. The basis of most of the officinal plasters is either lead plaster, a gum-resin, or Burgundy pitch.

In the preparation of plasters, care is requisite that the heat employed be not sufficiently elevated to produce decomposition, nor so long continued as to drive off any volatile ingredient upon which the virtues of the preparation may in any degree depend. After having been prepared, they are usually shaped into cylindrical rolls, and wrapped in paper to exclude the air. Plasters should be firm at ordinary temperatures, should spread easily when heated, and, after being spread, should remain soft, pliable, and adhesive, without melting, at the heat of the human body. When long kept, they are apt to change color and to become hard and brittle; and, as this alteration is most observable upon their surface, it must depend chiefly upon the action of the air, which should therefore be as much as possible excluded. The defect may usually be remedied by melting the plaster with a moderate heat and adding a sufficient quantity of oil to give it the due consistence. To soften the surface of a spread plaster, it should be brushed with a little tincture of camphor. Seventeen plasters are officinal.

Officinal Plasters containing Gum-Resins as their Basis.

Emplastrum Ammoniaci.	Made by digesting 100 parts of ammoniac in 140 parts of diluted acetic acid until emulsionized; then straining and evaporating by means of a water-bath until a small portion taken from the vessel hardens on cooling.
Emplastrum Ammoniaci cum Hydrargyro.	Made by adding 1 part of sublimed sulphur to 8 parts of heated olive oil, stirring, and then triturating thoroughly 180 parts of mercury with the mixture; then incorporating 720 parts of ammoniac, which has previously been digested in 1000 parts of diluted acetic acid, until emulsionized; lastly, adding sufficient melted lead plaster to make 1000 parts.
Emplastrum Asafœtidæ.	Made by digesting on a water-bath 35 parts of asafetida and 15 parts of galbanum with 120 parts of alcohol, straining, and evaporating to the consistence of honey; lastly, adding 35 parts of lead plaster and 15 parts of yellow wax, previously melted, and evaporating to the proper consistence.
Emplastrum Galbani.	Made by fusing together 16 parts of galbanum and 2 parts of turpentine; then incorporating thoroughly with 6 parts of melted Burgundy pitch, and, lastly, with 76 parts of melted lead plaster.

Officinal Plasters containing Lead or Resin Plaster as their Basis.

Emplastrum Arnicæ.	Made by incorporating thoroughly 50 parts of extract of arnica root with 100 parts of resin plaster, previously melted by means of a water-bath.
Emplastrum Belladonnæ.	Made by exhausting 100 parts of belladonna root with alcohol, evaporating at a temperature of about 122° F. to a soft extract, and, lastly, incorporating thoroughly sufficient melted resin plaster to make 100 parts.

Officinal Plasters containing Lead or Resin Plaster as their Basis.—(*Continued.*)

Emplastrum Ferri.	Made by melting together 70 parts of lead plaster, 10 parts of Canada turpentine, and 10 parts of Burgundy pitch; then adding 10 parts of hydrated oxide of Iron, and stirring until cool.
Emplastrum Hydrargyri.	Made by fusing together 10 parts of olive oil and 10 parts of resin, and, when cool, incorporating thoroughly 30 parts of mercury; lastly, adding 50 parts of lead plaster.
Emplastrum Opii.	Made by rubbing 6 parts of extract of opium with 8 parts of water until soft; then adding to it 18 parts of Burgundy pitch and 76 parts of lead plaster, previously melted together; lastly, heating and stirring until of the proper consistence.
Emplastrum Plumbi.	Made by rubbing gradually 32 parts of oxide of lead with 60 parts of olive oil, placing in a suitable vessel, and adding 10 parts of water to the mixture, boiling the whole together, and adding cautiously a little water, from time to time, as it is consumed.
Emplastrum Resinæ.	Made by adding 14 parts of resin to 80 parts of lead plaster and 6 parts of yellow wax, previously melted; then mixing the whole thoroughly.
Emplastrum Saponis.	Made by rubbing 10 parts of soap with sufficient water to form a soft mass; then mixing thoroughly with 90 parts of lead plaster previously melted.

Officinal Plasters containing Burgundy or Canada Pitch as their Basis.

Emplastrum Picis Burgundicæ.	Made by fusing together 90 parts of Burgundy pitch and 10 parts of yellow wax; stirring constantly until cool.
Emplastrum Picis Canadensis.	Made by fusing together 90 parts of Canada pitch with 10 parts of yellow wax; stirring constantly until cool.
Emplastrum Picis cum Cantharide.	Made by heating 8 parts of cerate of cantharides to about 212° F., straining, and adding to the strained liquid 92 parts of Burgundy pitch; lastly, melting them together and stirring until cool.

Officinal Spread Plasters.

Emplastrum Capsici.	Made by spreading a thin and even layer of melted resin plaster upon muslin, and allowing to cool; then applying a thin coating of oleoresin of capsicum by means of a brush.
Emplastrum Ichthyocollæ.	Made by dissolving 10 parts of isinglass in sufficient hot water to make the solution weigh 100 parts; then spreading one-half of this upon taffeta by means of a brush; then adding 1 part of glycerin and 40 parts of alcohol to the remaining solution, and applying in the same manner; lastly, coating the reverse of the taffeta with tincture of benzoin, and allowing to dry.

EMPLASTRUM AMMONIACI. *U.S.* Ammoniac Plaster.

	Definite formula.
Ammoniac, 100 parts, or	5 oz. av.
Diluted Acetic Acid, 140 parts, or	½ pint.

Digest the Ammoniac in the Diluted Acetic Acid, in a suitable vessel, avoiding contact with metals, until it is entirely emulsionized; then strain, and evaporate the strained liquid, by means of a water-bath, stirring constantly, until a small portion, taken from the vessel, hardens on cooling.

EMPLASTRUM AMMONIACI CUM HYDRARGYRO. *U.S.* Ammoniac Plaster with Mercury.

	Definite formula.
Ammoniac, 720 parts, or	13 oz. av.
Mercury, 180 parts, or	3¼ oz. av.
Olive Oil, 8 parts, or	60 grains.
Sublimed Sulphur, 1 part, or	8 grains.
Diluted Acetic Acid, 1000 parts, or	17 fl. oz.
Lead Plaster, a sufficient quantity,	
To make 1000 parts, or	18 oz. av.

Digest the Ammoniac in the Diluted Acetic Acid, in a suitable vessel, avoiding contact with metals, until it is entirely emulsionized; then strain, and evaporate the strained liquid by means of a water-bath, stirring constantly, until a small portion, taken from the vessel, hardens on cooling. Heat the Olive Oil, and gradually add the Sulphur, stirring constantly until they unite; then add the Mercury, and triturate until globules of the metal cease to be visible. Next add, gradually, the Ammoniac, while yet hot; and finally, having added enough Lead Plaster, previously melted by means of a water-bath, to make the mixture weigh *one thousand parts*, mix the whole thoroughly.

EMPLASTRUM ARNICÆ. *U.S.* Arnica Plaster.

	Definite formula.
Extract of Arnica Root, 50 parts, or	4 oz. av.
Resin Plaster, 100 parts, or	8 oz. av.

Add the Extract to the Plaster, previously melted by means of a water-bath, and mix them thoroughly.

EMPLASTRUM ASAFŒTIDÆ. *U.S.* Asafetida Plaster.

	Definite formula.
Asafetida, 35 parts, or	13 oz. av.
Lead Plaster, 35 parts, or	13 oz. av.
Galbanum, 15 parts, or	5½ oz. av.
Yellow Wax, 15 parts, or	5½ oz. av.
Alcohol, 120 parts, or	3 pints.

Digest the Asafetida and Galbanum with the Alcohol on a water-bath, separate the liquid portion, while hot, from the coarser impurities by straining, and evaporate it to the consistence of honey; then add the Lead Plaster and the Wax, previously melted together, stir the mixture well, and evaporate to the proper consistence.

EMPLASTRUM BELLADONNÆ. *U.S.* Belladonna Plaster.

Belladonna Root, in No. 60 powder, 100 parts, or	16 oz. av.
Alcohol,	
Resin Plaster, each, a sufficient quantity,	
To make 100 parts, or	16 oz. av.

Moisten the powder with *forty parts* [or 7 fl. oz.] of Alcohol, and pack it firmly in a cylindrical percolator; then add enough Alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding Alcohol, until the Belladonna Root is exhausted. Reserve the first *ninety parts* [or 14 fl. oz.] of the percolate; evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to *ten parts* [or 2 fl. oz.], mix this with the reserved portion and evaporate, at or below the above-mentioned temperature, to a soft, uniform extract. Add to this enough Resin Plaster, previously melted, to make the whole weigh *one hundred parts* [or 16 oz. av.], and mix thoroughly.

EMPLASTRUM CAPSICI. *U.S.* Capsicum Plaster.

Resin Plaster,
Oleoresin of Capsicum, each, a sufficient quantity.

Melt the Resin Plaster at a gentle heat, spread a thin and even layer of it upon muslin, and allow it to cool. Then, having cut off a piece of the required size, apply a thin coating of Oleoresin of Capsicum, by means of a brush, leaving a narrow, blank margin along the edges.

A space of four inches or ten centimetres square should contain *four grains*, or *twenty-five centigrammes*, of Oleoresin of Capsicum.

EMPLASTRUM FERRI. *U.S.* Iron Plaster. [Strengthening Plaster.]

	Definite formula.
Hydrated Oxide of Iron, dried at a temperature not exceeding 80° C. (176° F.), 10 parts, or	1 oz. av.
Canada Turpentine, 10 parts, or	1 oz. av.
Burgundy Pitch, 10 parts, or	1 oz. av.
Lead Plaster, 70 parts, or	7 oz. av.
To make 100 parts, or	10 oz. av.

Melt the Lead Plaster, Canada Turpentine, and Burgundy Pitch by means of a water-bath; then add the Oxide of Iron, and stir constantly until the mixture thickens on cooling.

EMPLASTRUM GALBANI. *U.S.* Galbanum Plaster.

	Definite formula.
Galbanum, 16 parts, or	8 oz. av.
Turpentine, 2 parts, or	1 oz. av.
Burgundy Pitch, 6 parts, or	3 oz. av.
Lead Plaster, 76 parts, or	38 oz. av.
To make 100 parts, or	50 oz. av.

To the Galbanum and Turpentine, previously melted together and strained, add, first, the Burgundy Pitch, then the Lead Plaster, melted over a gentle fire, and mix the whole thoroughly.

EMPLASTRUM HYDRARGYRI. *U.S.* Mercurial Plaster.

	Definite formula.
Mercury, 30 parts, or	3 oz. av.
Olive Oil, 10 parts, or	1 oz. av.
Resin, 10 parts, or	1 oz. av.
Lead Plaster, 50 parts, or	5 oz. av.
To make 100 parts, or	10 oz. av.

Melt the Olive Oil and Resin together, and, when the mixture has become cool, rub the Mercury with it until globules of the metal cease to be visible. Then gradually add the Lead Plaster, previously melted, and mix the whole thoroughly.

EMPLASTRUM ICHTHYOCOLLÆ. *U.S.* Isinglass Plaster.

[COURT PLASTER.]

	Definite formula.
Isinglass, 10 parts, or	155 grains.
Alcohol, 40 parts, or	1¼ fl. oz.
Glycerin, 1 part, or	12 minims.
Water,	
Tincture of Benzoin, each, a sufficient quantity.	

Dissolve the Isinglass in a sufficient quantity of hot Water to make the solution weigh *one hundred and twenty parts* [or measure 4 fl. oz.]. Spread one-half of this, in successive layers, upon taffeta (stretched on a level surface), by means of a brush, waiting after each application until the layer is dry. Mix the second half of the Isinglass solution with the Alcohol and Glycerin, and apply it in the same manner. Then reverse the taffeta, coat it on the back with Tincture of Benzoin and allow it to become perfectly dry.

Cut the plaster in pieces of suitable length, and preserve them in well-closed vessels.

Substituting *gramme* (15.5 *grains*) for *part*, the above quantities are sufficient to cover a piece of taffeta fifteen inches or thirty-eight centimetres square.

EMPLASTRUM OPII. *U.S.* Opium Plaster.

	Definite formula.
Extract of Opium, 6 parts, or	1 oz. av.
Burgundy Pitch, 18 parts, or	3 oz. av.
Lead Plaster, 76 parts, or	12½ oz. av.
Water, 8 parts, or	1½ fl. oz.
To make 100 parts, or	17 oz. av.

Rub the Extract of Opium with the Water, until uniformly soft, and add it to the Burgundy Pitch and Lead Plaster, melted together by means of a water-bath; then continue the heat for a short time, stirring constantly, until the moisture is evaporated.

EMPLASTRUM PICIS BURGUNDICÆ. *U.S.* Burgundy Pitch Plaster.

	Definite formula.
Burgundy Pitch, 90 parts, or	9 oz. av.
Yellow Wax, 10 parts, or	1 oz. av.
To make 100 parts, or	10 oz. av.

Melt them together, strain the mixture, and stir constantly until it thickens on cooling.

EMPLASTRUM PICIS CANADENSIS. *U.S.* Canada Pitch Plaster.

[HEMLOCK PITCH PLASTER.]

	Definite formula.
Canada Pitch, 90 parts, or	9 oz. av.
Yellow Wax, 10 parts, or	1 oz. av.
To make 100 parts, or	10 oz. av.

Melt them together, strain the mixture, and stir constantly until it thickens on cooling.

EMPLASTRUM PICIS CUM CANTHARIDE. *U.S.* **Pitch Plaster with Cantharides.** [WARMING PLASTER.]

	Definite formula.
Burgundy Pitch, 92 parts, or	23 oz. av.
Cerate of Cantharides, 8 parts, or	2 oz. av.
To make 100 parts, or	25 oz. av.

Heat the Cerate as nearly as possible to 100° C. (212° F.) on a water-bath, and, having continued the heat for fifteen minutes, strain it through a close strainer which will retain the Cantharides. To the strained liquid add the Pitch, melt them together by means of a water-bath, and, having removed the heat, stir the mixture constantly until it thickens on cooling.

EMPLASTRUM PLUMBI. *U.S.* **Lead Plaster.** [DIACHYLON PLASTER.]

	Definite formula.
Oxide of Lead, in very fine powder, 32 parts, or	32 oz. av.
Olive Oil, 60 parts, or	63 fl. oz.
Water, a sufficient quantity.	

Rub the Oxide of Lead with about one-half of the Olive Oil, and add the mixture to the remainder of the Oil, contained in a suitable vessel of a capacity equal to three times the bulk of the ingredients. Then add *ten parts* [or 10 fl. oz.] of boiling Water, and boil the whole together until a homogeneous plaster is formed, adding, from time to time, during the process, a little Water, as that first added is consumed.

Lead plaster is white, pliable, and tenacious, free from greasiness or stickiness. It should be entirely soluble in warm oil of turpentine (absence of uncombined oxide of lead).

EMPLASTRUM RESINÆ. *U.S.* **Resin Plaster.** [ADHESIVE PLASTER.]

	Definite formula.
Resin, in fine powder, 14 parts, or	7 oz. av.
Lead Plaster, 80 parts, or	40 oz. av.
Yellow Wax, 6 parts, or	3 oz. av.
To make 100 parts, or	50 oz. av.

To the Lead Plaster and Wax, melted together over a gentle fire, add the Resin, and mix them.

EMPLASTRUM SAPONIS. *U.S.* **Soap Plaster.**

	Definite formula.
Soap, dried and in coarse powder, 10 parts, or	1 oz. av.
Lead Plaster, 90 parts, or	9 oz. av.
Water, a sufficient quantity.	

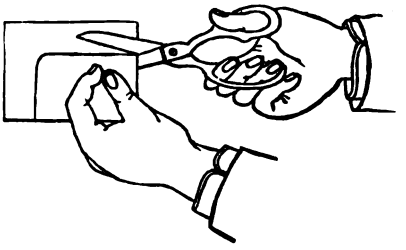
Rub the Soap with Water until brought to a semi-liquid state; then mix it with the Lead Plaster, previously melted, and evaporate to the proper consistence.

Spreading Plasters.—Since the introduction of machine-spread plasters the preparation of a plaster by a pharmacist upon the prescription of a physician has become almost a "lost art."

Plasters are prepared for use by spreading them upon leather, muslin, or paper, according to the particular purposes they are intended to

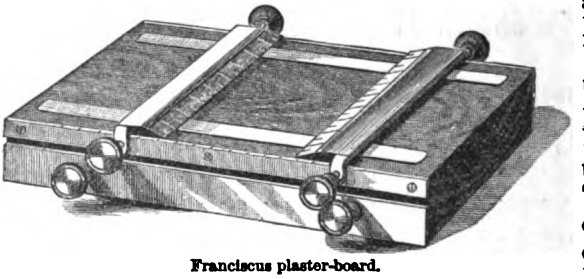
answer. Leather is most convenient when the application is made to the sound skin, muslin when the plaster is used as a dressing to ulcerated or abraded surfaces or with the view of bringing and retaining together the sides of wounds. The leather usually preferred is white sheep-skin, or the kind known commercially as "hemlock splits." A margin about a quarter or half an inch broad should usually be left uncovered, in order to facilitate the removal of the plaster and to prevent the clothing in contact with its edges from being soiled. An accurate outline may be obtained by pasting, or fastening with thumb-tacks, upon the leather a piece of paper so cut as to leave in the centre a vacant space of the required dimensions, and removing the paper when no longer needed. The paper is folded four times. Fig. 480 shows one-fourth of the whole in the act of being cut: the rounded corners give a neater finish than square ones. The same object may often be accomplished by employing two narrow rulers of sheet-tin graduated in inches, and so shaped that each of them will form two sides of a rectangle. These may be applied in such a manner as to enclose within them any given rectangular space, and may be fixed by weights upon the leather, or preferably adjusted by set-screws, while the plaster is spread. The Franciscus machine is constructed on this principle (see Fig. 481).[1] For any other shape, as in the case of plasters for the breast, pieces of tin may be employed having a space within, corresponding to the required outline. Figs. 482, 483, 484, 485, 486, 487, 488, and 489 show patterns for plasters with margins for various parts of the body. Figs. 482 and 483 are for use behind the ears, the pointed portion of the plasters being used for the top. Care must be observed to have the physician designate whether the plaster is intended for the right ear (Fig. 483) or the left ear (Fig. 482). Chest plasters are sometimes cut in the shape of Fig. 484; those intended for use between the shoulders may have the form of Fig. 485. In Fig. 486 a plaster is shown which is intended for the "small of the back," and in Fig. 487 is one for either the right or the left side. Fig. 488 shows a pattern for fastening to kid, to spread a breast plaster on, and Fig. 489 represents the plaster

Fig. 480.



Cutting plaster-paper.

Fig. 481.

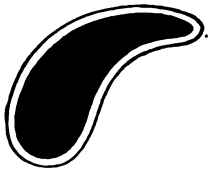


Franciscus plaster-board.

[1] The other side of this valuable apparatus can be used as a lozenge-board or pill-machine.

with the margin as spread from such a pattern. The spreading of the plaster is most conveniently accomplished by the use of a spatula or

FIG. 482.



Left ear plaster.

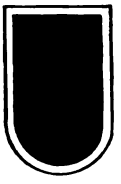
FIG. 483.

Right ear plaster.

FIG. 484.

Chest plaster.

FIG. 485.



Shoulder plaster.

plaster-iron (see Fig. 491). This may be heated by means of a spirit-lamp. Care must be taken that the instrument be not so hot as to discolor or decompose the plaster; and special care is requisite in the case of those plasters which contain a volatile ingredient. A sufficient portion of the plaster should first be melted by the heated instrument, and, having been received on a piece of coarse stiff paper, or in a shallow tin tray open on one side, should, when nearly cool, be transferred to the leather and applied quickly and evenly over its surface. By this plan the melted plaster is prevented from penetrating the leather, as it would be apt to do if applied too hot. Before removing the paper from the edge of the plaster, if this has become so hard as to crack, the iron should be drawn over the line of junction. Fig. 490 shows one method of spreading a small plaster with a spatula. Strips of paper are fastened upon the kid with thumb-tacks (such as are used by draughtsmen: one is shown in the cut in profile), a piece of waste paper is fastened at the top to prevent soiling the margin, the melted plaster is poured upon it, and the spatula, having been previously warmed by

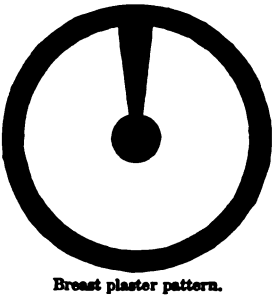
FIG. 486.

Back plaster.

FIG. 487.

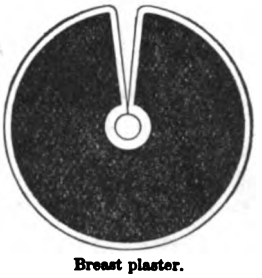
Side plaster.

FIG. 488.



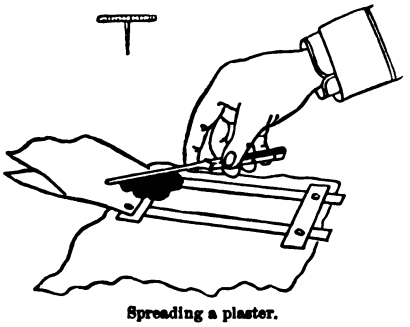
Breast plaster pattern.

FIG. 489.



Breast plaster.

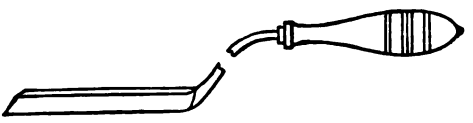
FIG. 490.



Spreading a plaster.

passing it through an alcohol flame or that of a Bunsen burner, is used by quickly passing the edge of the blade over the surface; a portion of the melted plaster precedes the blade in its passage, and thus a thin layer is spread upon the leather. Especial care must be observed not to allow very hot plaster to remain upon the leather, or it may pass through and discolor the back. For large plasters, the plaster-iron (see Fig. 491) may be employed; this is heated, and, owing to the greater weight of metal, it holds the heat much better than the blade of a spatula: it is, however, not so easily nor so quickly used as the latter instrument by those unaccustomed to it. After the plaster has been spread, the strips of paper are carefully removed, and if the plaster is brittle it should be held near the source of heat, so that the strips may be removed without tearing off pieces of the plaster from the leather.

FIG. 491.



Plaster-iron.

Large quantities of stock plasters may be spread by the apparatus shown below. To an oblong rectangular block of hard wood, slightly convex on its upper surface, is attached by a movable joint a sheet-

FIG. 494.

Plaster-awl.

FIG. 492.

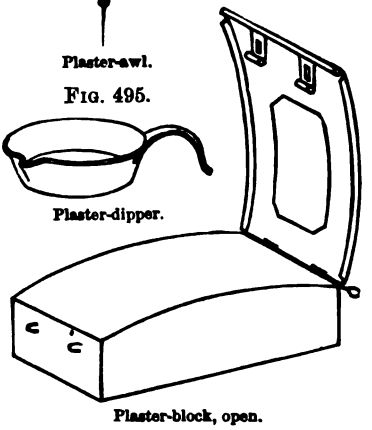
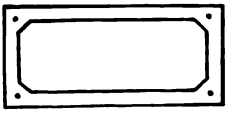


FIG. 496.

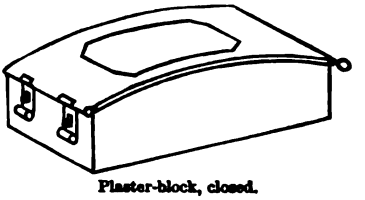


Plaster-pattern.

FIG. 495.

Plaster-dipper.

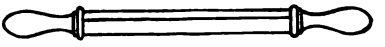
FIG. 493.



Plaster-block, open.

Plaster-block, closed.

FIG. 497.



Plaster-iron (double handle).

iron frame, with an opening of the dimensions of the plaster to be spread, and clasps at the other end, by which this may be fixed to the block (see Fig. 492). Another portion of the apparatus is a sheet-iron or tin frame, by which the leather is cut out and the margin marked (see Fig. 496). The leather thus prepared is laid on the convex surface of the block; the sheet-iron frame is brought down on it evenly, as shown in Fig. 493;

the plaster, previously melted, but not too hot, is poured on the leather in the centre, and, by means of a square iron bar having a wooden handle at each end (see Fig. 497), which has been heated by a spirit-lamp, it is spread uniformly over the surface, the thickness being regulated by the frame against which the iron is pressed. Any excess of plaster is thus pressed over upon the frame. The heated point of an awl (see Fig. 494) is then drawn along the interior edge of the frame so as to separate the plaster from it, after which the clasps are unfastened and the plaster removed.

The dipper shown in Fig. 495 is well adapted for holding suitable quantities for spreading plasters extemporaneously. If a portion of the various roll plasters be melted and run into a number of these, and the dippers labelled, they will be found very convenient as containers.

Blisters do not usually require the application of heat to spread them: they may be spread on adhesive plaster in the same way as plasters are prepared. The spatula shown in Fig. 498 is well fitted for spreading blisters, as it gives room for the fingers and permits a solid grasp of the handle. The practice of using the thumb in spreading blisters, although

FIG. 498.

Blister-spatula.

tolerated by many good pharmacists, should be regarded as more honored in the breach than in the observance: it is an unnecessary and inelegant procedure, the spatula giving a much smoother finish.

Chartæ. *Papers.*

Papers are a small class of preparations intended for external application, made either by saturating paper with medicinal substances, or by applying the latter to the surface of the paper by the addition of some adhesive liquid. Only three papers are officinal: they are as follows:

CHARTA CANTHARIDIS. *U. S.* Cantharides Paper.

	Definite formula.
White Wax, 8 parts, or	4 oz. av.
Spermaceti, 3 parts, or	1½ oz. av.
Olive Oil, 4 parts, or	2 fl. oz.
Canada Turpentine, 1 part, or	½ oz. av.
Cantharides, in No. 40 powder, 1 part, or	½ oz. av.
Water, 10 parts, or	5 fl. oz.

Mix all the substances in a tinned vessel, and boil gently for two hours, constantly stirring. Strain through a woollen strainer without expressing, and, by means of a water-bath, keep the mixture in a liquid state in a shallow, flat-bottomed vessel with an extended surface. Coat strips of sized paper with the melted plaster, on one side only, by passing them successively over the surface of the liquid; when dry, cut the strips into rectangular pieces.

CHARTA POTASSII NITRATIS. *U. S.* Nitrate of Potassium Paper.

Definite formula.

Nitrate of Potassium, 20 parts, or . . . . . 1 oz. av.
Distilled Water, 80 parts, or . . . . . 4 fl. oz.

Dissolve the Nitrate of Potassium in the Distilled Water. Immerse strips of white, unsized paper in the solution, and dry them.

Keep the paper in securely closed vessels.

CHARTA SINAPIS. *U. S.* Mustard Paper.

Black Mustard, in No. 60 powder,
Benzin,
Solution of Gutta-Percha, each, a sufficient quantity.

Pack the Mustard tightly in a conical percolator, and gradually pour Benzin upon it until the percolate ceases to produce a permanent, greasy stain upon blotting-paper. Remove the powder from the percolator, and dry it by exposure to the air. Then mix it with so much of Solution of Gutta-Percha as may be necessary to give it a semi-liquid consistence, apply the mixture, by means of a suitable brush, to one side of a piece of rather stiff, well-sized paper, so as to cover it completely, and allow the surface to dry.

Each square inch (or 6.5 square centimetres) of paper should contain about *six grains*, or *forty centigrammes*, of Mustard.

Before being applied to the skin, the Mustard Paper should be dipped in warm water for about fifteen seconds.

PART VI.

FORMULARY OF UNOFFICINAL PREPARATIONS.

THE following formulas have been collected principally with the view of saving the labor and time of the pharmacist, who is often suddenly called upon to prepare some remedy for which he may not have a formula in his recipe-book. The author's name is appended to the formula when it is known, and the selection has been carefully made so as to embrace many which are not easy of access. The subjects are arranged according to the order adopted for the officinal preparations in Parts III. and IV., and, if desired, they may be consulted in connection with the subjects in those parts. The formulas of the preparations of the U.S. Pharmacopœia, 1870, which were not admitted to the present Pharmacopœia, have been added, because many of them are still in active use.

INORGANIC ACIDS.

Hydrobromic Acid Cough Mixture.

(Dr. J. Milner Fothergill's.)

Spirit of Chloroform, B. P.,	40 min.
Hydrobromic Acid (Diluted),	60 min.
Syrup of Squill,	2 fl. dr.
Water, sufficient to make	2 fl. oz.

Mix. Dose for an adult, a tablespoonful.

Styptic Balsam.

(Warren's.)

Sulphuric Acid,	5 fl. dr.
Oil of Turpentine, Alcohol,	of each, 4 fl. dr.

Place the Acid in a wedgwood mortar, and add the Oil of Turpentine slowly, stirring it constantly with the pestle; then add the Alcohol in the same manner, and continue stirring it until no more fumes arise, when it may be bottled (use ground-stoppered bottles). Used for chilblains and as a stimulating embrocation.

Boroglyceride.

Boric Acid,	300 gr.
Glycerin,	1 fl. oz.

Heat to about 302° F., as long as aqueous vapors are given off.

Glycerite of Boric Acid.

Boric Acid,	180 gr.
Glycerin,	1 fl. oz.

Dissolve the Acid in the Glycerin, suspended in a hot-water bath until dissolved.

Boric Acid Cotton.

Purified Cotton Wool, sufficient.

Boric Acid,	60 gr.
Water,	9 fl. dr.

Dissolve the Boric Acid in the Water at a temperature of 60° C. (140° F.); saturate the Purified Cotton with this solution, press it, dry it, and preserve in wide-mouth, cork-stoppered vials.

Boric Acid Ointment.

(Lister's.)

Boric Acid,	240 gr.
White Wax,	240 gr.
Paraffin,	1 oz. (troy).
Almond Oil,	1 fl. oz.

Mix.

Boric Acid Ointment.

Glycerite of Boric Acid,	2 fl. dr.
White Wax,	240 gr.
Vaseline,	3 fl. oz.

Heat the Wax and Vaseline together, and while hot add the Glycerite slowly; use constant stirring while cooling.

BROMINE.

Antidote to the Poison of the Rattlesnake.

(Bibron's.)

Bromine,	150 gr.
Potassium Iodide,	2 gr.
Corrosive Chloride of Mercury,	1 gr.
Diluted Alcohol,	4 fl. oz.

Dissolve. Take 10 drops in a tablespoonful of brandy, repeated as required.

Solution of Bromine.

(Dr. J. Lawrence Smith's.)

Bromine,	240 gr.
Potassium Bromide,	80 gr.
Distilled Water,	2 fl. oz.

Dissolve the Potassium Bromide in about 1 fl. oz. of the Distilled Water, add the Bromine, agitate, and finally add the remainder of the Distilled Water. It should be kept in small, ground-stoppered vials. Dose, 1 to 2 drops.

Bromine Inhalation.

(Netolitsky's.)

Bromine,	16 gr.
Potassium Bromide,	16 gr.
Distilled Water,	7 fl. oz.

Dissolve. To be poured, a small quantity at a time, upon a sponge or lint for inhalation in croup.

IODINE.

Iodized Glycerin.

Iodized Oil of Bitter Almond,	1 fl. dr.
Glycerin,	7 fl. dr.

Mix. See next formula.

Iodized Oil of Bitter Almond.

Iodine,	20 gr.
Oil of Bitter Almond,	1 fl. dr.

Mix, and shake occasionally for two months.

Unguentum Iodinii Compositum. *U. S.* 1870. Compound Iodine Ointment.

Iodine,	15 gr.
Iodide of Potassium,	30 gr.
Water,	30 min.
Lard,	1 oz. (troy).

Dissolve the Iodine and Iodide of Potassium in the water, then incorporate the solution with the Lard.

Iodized Phenol.

(Battey's formula.)

Iodine,	240 gr.
Carbolic Acid,	1 fl. oz.

Mix. It is to be diluted generally with equal parts of Glycerin, and applied twice a day.

Tinctura Iodinii Composita. *U. S.* 1870. Compound Tincture of Iodine.

Iodine,	240 gr.
Iodide of Potassium,	1 oz. (troy).
Alcohol,	16 fl. oz.

Dissolve the Iodine and Iodide of Potassium in the Alcohol.

Boulton's Solution, or Solution of Carbolate of Iodine.

Compound Tincture of Iodine,	22 min.
Carbolic Acid,	3 gr.
Glycerin,	4 fl. dr.
Water,	2½ fl. oz.

Mix. Used in inhalations, etc.

Iodinal Collodion.

(J. T. Shinn's.)

Iodine,	120 gr.
Canada Turpentine,	2 fl. dr.
Collodion,	8 fl. oz.

Dissolve the Iodine and Turpentine in the Collodion. Used as a substitute for Iodine Ointment.

Iodine Solution.

(Magendie's.)

Potassium Iodide,	240 gr.
Iodine,	2 gr.
Peppermint Water,	6 fl. oz.

Dissolve. Dose, a teaspoonful.

Iodine Caustic.

(Churchill's.)

Iodine,	60 gr.
Potassium Iodide,	120 gr.
Water,	4 fl. dr.

Mix. Used externally.

Iodine Caustic.

(Rieseberg's.)

Iodine,	1 oz. (troy).
Glycerin,	2 fl. oz.

Applied every second day with a brush. As the preparation is very powerful, its effect must be watched.

Coster's Paste.

Iodine Pigment,	120 gr.
Oil of Cade,	1 oz. (troy).

Mix. For an embrocation. This preparation should not be used until it has stood four weeks. The Iodine Pigment is made by dissolving 60 gr. of Iodine in 1 fl. oz. of Alcohol, and allowing the solution to stand in a glass bottle for several months before use.

Iodized Cotton.

Iodine,	60 gr.
Purified Cotton,	1½ fl. oz.

Enclose the Iodine in filtering-paper, and place it at the bottom of a flask with a wide mouth; then introduce the Cotton, and close the flask by covering the mouth. Place the flask in a moderately warm place until the Cotton appears to be uniformly colored by the Iodine.

Tincture of Iodine.

(Churchill's.)

Iodine,	60 gr.
Potassium Iodide,	120 gr.
Water,	
Alcohol,	of each, 2 fl. oz.

Mix. Dose, 5 to 15 drops.

Decolorized Tincture of Iodine.

Iodine,	1½ oz.
Stronger Water of Ammonia,	3 fl. oz.
Alcohol,	13 fl. oz.

Dissolve the Iodine in the Alcohol and add the Ammonia. Allow it to stand for

four weeks, with occasional agitation, until the precipitate is dissolved. It is a solution of Ammonium Iodide and Iodate.

Ethereal Tincture of Iodine.

(Magendie's.)

Iodine,	32 gr.
Ether,	1 fl. oz.

Dissolve. Used externally.

SULPHUR.

Unguentum Sulphuris Iodidi. *U. S.* 1870. Ointment of Iodide of Sulphur.

Iodide of Sulphur,	30 gr.
Prepared Lard,	1 oz. (troy).

Triturate the Iodide of Sulphur in a porcelain mortar, and gradually add the Lard, rubbing them together until the ointment is perfectly smooth and free from grittiness.

Vleminckx's Solution.

Lime,	240 gr.
Sublimed Sulphur,	1 oz. (troy).
Water,	10 fl. oz.

Boil down to 6 fl. oz. and filter. Used externally in acne.

Wilkinsonian Ointment.

(North-West Dispensary.)

Sublimed Sulphur,		
Oil of Cade,	of each,	240 gr.
Calcium Carbonate,		160 gr.
Green Soap,		
Lard,	of each,	1 oz. (troy).

PHOSPHORUS.

Syrup of the Hypophosphites.

(Parrish's.)

Calcium Hypophosphite,	360 gr.
Sodium Hypophosphite,	120 gr.
Potassium Hypophosphite,	120 gr.
Sugar,	13 oz. (troy).
Hot Water,	10 fl. oz.
Orange Flower Water,	4 fl. dr.

Dissolve the salts in the Hot Water, filter through paper, dissolve the Sugar in the solution by the aid of heat, strain, and add the Orange-Flower Water. Dose, a teaspoonful, containing nearly 5 gr. of the mixed salts.

Compound Solution of the Hypophosphites of Iron, Soda, Lime, and Magnesium.

Calcium Hypophosphite,	11 oz. 80 gr. av.
Oxalic Acid,	1½ oz. av.
Ferrous Sulphate,	2 oz. av. 260 gr.
Sodium Sulphate,	5 oz. av. 120 gr.
Magnesium Sulphate,	1 oz. av. 420 gr.
Boiling Water,	5 pints.
Water, a sufficient quantity to make	100 fl. oz.

Dissolve the Calcium Hypophosphite in the Boiling Water, add the Oxalic Acid, stirring for a minute, and then the other ingredients in the order given. Agitate for two or three minutes, allow the mixture to become cold, filter into a bottle marked 100 fl. oz., and wash the Calcium Oxalate and Sulphate, which remain on the filter, with Water until 100 fl. oz. of liquid are obtained.

Solution of the Hypophosphites.

(Hayes's.)

Calcium Hypophosphite,	128 gr.
Potassium Hypophosphite,	128 gr.
Sodium Hypophosphite,	32 gr.
Quinine Hypophosphite,	32 gr.
Manganese Hypophosphite,	32 gr.
Iron Hypophosphite,	64 gr.
Strychnine Hypophosphite,	1 gr.
Glycerin,	384 min.
Solution of Hypophosphorous Acid,	256 min.
Water, sufficient to make	16 fl. oz.

Dissolve.

Compound Solution of Hypophosphite of Iron.

(Dr. Frederick Churchill's.)

Iron Hypophosphite,	212 gr.
Calcium Hypophosphite,	268 gr.
Sodium Hypophosphite,	268 gr.
Magnesium Hypophosphite,	152 gr.
Hypophosphorous Acid,	127 min.
Water, sufficient to make	16 fl. oz.

Syrup of Hypophosphites.

(Thompson's. Containing Ferrous Hypophosphite.)

Calcium Hypophosphite,	256 gr.
Sodium Hypophosphite,	192 gr.
Potassium Hypophosphite,	128 gr.
Ferrous Sulphate,	185 gr.
Sodium Carbonate,	240 gr.
Hypophosphorous Acid (sp. gr. 1.036),	3½ fl. oz.
Sugar,	12 oz. (av.).
Water, sufficient.	

Dissolve the Ferrous Sulphate and Sodium Carbonate, each separately, in 4 fl. oz. of Water, and mix the solutions. Wash the precipitated Carbonate thoroughly with sweetened Water, and drain it on a muslin filter. Having placed the salts of Calcium, Sodium, and Potassium in a suitable porcelain dish, add about 2 fl. oz. of Water and 1 fl. oz. of Hypophosphorous Acid; heat the mixture gently, and add the moist Carbonate, in small portions, from time to time, alternately with the Hypophosphorous Acid, until the solution is complete. Add Water enough to make the whole measure 10 fl. oz.; pour it into a bottle containing the Sugar, and agitate until the Sugar is dissolved. Dose, a teaspoonful.

Compound Syrup of Hypophosphites.

(Containing Ferric Hypophosphite. Procter's.)

Calcium Hypophosphite,	256 gr.
Sodium Hypophosphite,	192 gr.
Potassium Hypophosphite,	128 gr.
Ferric Hypophosphite,	96 gr.
Hypophosphorous Acid Solution,	240 min.
Sugar,	9 oz. (av.).
Extract of Vanilla,	4 fl. dr.
Water, sufficient.	

Dissolve the salts of Calcium, Sodium, and Potassium in 6 fl. oz. of Water; put the Iron salt in a mortar, and gradually add solution of Hypophosphorous Acid till it is dissolved; to this add the solution of the other salts, after it has been rendered slightly acidulous with the same acid, and then Water, till the whole measures 12 fl. oz. Dissolve in this the Sugar, with heat, and add the Vanilla. Dose, a teaspoonful.

Solution of Phosphates.

(Dr. Pepper's.)

Calcium Phosphate,	6 gr.
Magnesium Phosphate,	4 gr.
Potassium Phosphate,	3 gr.
Phosphoric Acid (Concent.),	10 min.
Water, sufficient to make	2 fl. dr.

Make a solution and filter.

Compound Solution of Phosphates.

Calcium Carbonate,	369 gr.
Magnesia (Calc.),	29 gr.
Potassium Carbonate,	25 gr.
Iron Phosphate,	64 gr.
Phosphoric Acid (60 per cent.),	1705 gr.
Water, sufficient to make	16 fl. oz.

Mix the Acid with half a pint of Water, add the Iron Phosphate, and stir until dissolved; then add gradually the Calcium Carbonate, stirring until effervescence ceases and the freshly-formed Phosphate is dissolved, and finally add the Magnesia and Potassium Carbonate; stir until dissolved, and make up the measure to 1 pint. Used as an *acid phosphate*.

Solution of Phosphorus.

(Thompson's.)

Phosphorus,	1 gr.
Spirit of Peppermint,	40 min.
Alcohol,	2 fl. dr.
Absolute Alcohol,	5 fl. dr.
Glycerin,	12 fl. dr.

Dissolve the Phosphorus first in the Absolute Alcohol with the aid of a gentle heat; then add the Alcohol and Glycerin previously warmed; lastly, add the Spirit of Peppermint.

POTASSIUM SALTS.

Effervescing Draught.

Potassium Bicarbonate,	80 gr.
Water,	2 fl. oz.

Make a solution. Take a tablespoonful of lemon-juice diluted with a tablespoonful of Water, and add to it in a tumbler a tablespoonful of this solution, then drink immediately.

Muller's Fluid.

Potassium Bichromate,	200 gr.
Sodium Sulphate,	80 gr.
Water,	16 fl. oz.

Brown-Séquard's Anti-Epileptic Mixture.

Sodium Bromide,	180 gr.
Potassium Bromide,	180 gr.
Ammonium Bromide,	180 gr.
Potassium Iodide,	90 gr.
Ammonium Iodide,	90 gr.
Ammonium Carbonate,	60 gr.
Tincture of Calumba,	1½ fl. oz.
Water, sufficient to make	8 fl. oz.

Mix. Adult dose, 1½ teaspoonfuls before each meal, and 3 teaspoonfuls at bedtime.

Elixir of Bromide of Potassium.

Potassium Bromide,	640 gr.
Elixir of Orange,	8 fl. oz.

Reduce the Bromide to a powder, and dissolve in the warmed elixir.

Whooping-Cough Remedy.

(Dr. J. J. Caldwell's.)

Ammonium Bromide,	20 gr.
Potassium Bromide,	40 gr.
Fluid Extract of Belladonna,	6 min.
Distilled Water,	2 fl. oz.

Used with steam atomizer for ten to fifteen minutes morning, noon, and bedtime.

Pancoast's Styptic.

Potassium Carbonate,	120 gr.
Soap,	30 gr.
Alcohol,	1 fl. oz.

Mix.

Antidiphtheritic Mixture.

(Warren's.)

Thymol,	4 gr.
Potassium Chlorate,	75 gr.
Quinine Sulphate,	45 gr.
Hydrochloric Acid,	15 min.
Glycerin,	2 fl. oz.
Brandy,	9 fl. oz.

Dose, a teaspoonful every hour for children between two and five years.

Laxative Powder.

(Jeannel's.)

Potassium and Sodium Tartrate,	600 gr.
Sodium Bicarbonate,	240 gr.
Tartaric Acid,	240 gr.
Oil of Lemon, sufficient.	
Sugar,	2½ oz. (troy).

Dose, a teaspoonful in sweetened water.

Liniment of Iodide of Potassium.

Soap,	420 gr.
Potassium Iodide,	360 gr.
Oil of Lavender,	15 min.
Alcohol,	4 fl. oz.
Water,	6 fl. dr.

Dissolve the Soap in the Alcohol by means of a gentle heat, and filter if it is not perfectly transparent; then add the Oil and the Potassium Iodide dissolved in the Water; mix, and bottle it while warm.

Spleen Mixture.

(Gadberry's.)

Potassium Nitrate,	300 gr.
Quinine Sulphate,	65 gr.
Iron Sulphate,	65 gr.
Nitric Acid,	65 min.
Water,	16 fl. oz.

Mix. Dose, a tablespoonful three times a day.

Liquor Potassii Permanganatis. *U. S.* 1870. SOLUTION OF PERMANGANATE OF POTASSIUM.

Permanganate of Potassium,	64 gr.
Distilled Water,	16 fl. oz.

Dissolve the Permanganate in the Distilled Water.

Benzoated Alkaline Mixture.

(Dr. Ellwood Wilson.)

Potassium Bicarbonate,	90 gr.
Benzoic Acid,	30 gr.
Syrup of Orange,	4 fl. dr.
Water,	2½ fl. oz.

Rub the solids with 4 fl. dr. of Water until effervescence ceases, then add the rest of the Water, filter, and add the Syrup. Dose, a tablespoonful three times a day after meals.

SODIUM SALTS.

Neutralizing Powder.

Sodium Bicarbonate,	120 gr.
Powdered Rhubarb,	120 gr.
Oil of Peppermint,	2 min.

Dose, a teaspoonful, as an antacid in diarrhœa and dyspepsia.

Anti-Gout Pills.

(Corlieu's.)

Sodium Silicate,	20 gr.
Extract of Colchicum,	12 gr.
Extract of Aconite,	25 gr.
Sodium Benzoate,	40 gr.
Powdered Soap,	40 gr.

Mix, and make into 100 pills.

Soda Mint.

Sodium Bicarbonate,	336 gr.
Spearmint Water,	1 pint.

Dissolve and filter. Dose, a tablespoonful.

Mel Sodii Boratis. *U. S.* 1870. HONEY OF BORATE OF SODIUM.

Borate of Sodium, in fine powder,	60 gr.
Clarified Honey,	1 oz. (troy).

Mix them.

Aromatic and Antacid Corrective of Indigestion.

(Dr. J. J. Levick.)

Sodium Bicarbonate,	80 gr.
Compound Tincture of Cardamom,	4 fl. dr.
Compound Infusion of Gentian,	2½ fl. oz.
Peppermint Water,	3 fl. oz.

Mix. A tablespoonful as required.

Glyceritum Sodii Boratis. *U. S.* 1870. GLYCERITE OF BORAX.

Sodium Borate,	2 oz. (troy).
Glycerin,	8 fl. oz.

Rub them together in a mortar until the Sodium Borate is dissolved.

Collyrium of Borate of Sodium.

Sodium Borate,	4 gr.
Camphor Water,	1 fl. oz.

Mix.

Troches of Borax.

Sodium Borate,	150 gr.
Powdered Sugar,	1800 gr.
Carmine, No. 40,	1½ gr.
Tragacanth (in flakes),	5 gr.
Distilled Water,	120 min.
Tincture of Benzoin,	20 min.

Prepare a mucilage from the Tragacanth, with the addition of the Water and Tincture. Dissolve the Carmine in 30 minims of Water of Ammonia. Mix the dry ingredients together, add the Carmine solution and sufficient Tragacanth mucilage to form a mass. Divide the mass into 100 troches, each weighing 20 gr. and containing 1½ gr. of Sodium Borate.

Nipple Wash.

(Dr. Atlee's.)

Sodium Borate,	60 gr.
Acacia,	120 gr.
Tincture of Myrrh,	2 fl. dr.
Rose Water,	2 fl. oz.

Dissolve the Borate in the Rose Water; make a thick mucilage with the Acacia, and emulsify the Tincture of Myrrh; then add the rest of the solution.

Hay-Fever Snuff.

(Dr. Mortimer Granville's.)

Sodium Borate,	20 gr.
Capsicum,	15 gr.
Ammonium Carbonate,	10 gr.

Mix.

AMMONIUM SALTS.

Carbonate of Ammonium Mixture.

Ammonium Carbonate,	90 gr.
Powdered Acacia,	90 gr.
Sugar,	90 gr.
Aromatic Spirit of Ammonia,	2 fl. dr.
Compound Tincture of Cardamom,	2 fl. dr.
Water,	3½ fl. oz.

Mix. A tablespoonful every two or three hours.

Ammonia Lozenges.

(Dr. Jackson's.)

Ammonium Chloride,	90 gr.
Morphine Hydrochlorate,	3 gr.
Powdered Elm,	360 gr.
Powdered Acacia,	420 gr.
Powdered Sugar,	420 gr.
Powdered Extract of Glycyrrhiza,	420 gr.
Oil of Sassafras,	4 min.
Tincture of Tolu,	3 fl. dr.

To be made with syrup into 180 lozenges, or into lozenges of 10 gr. each, containing ½ gr. of Ammonium Chloride and $\frac{1}{60}$ gr. of Morphine Hydrochlorate.

Asthma Mixture.

(Fothergill's.)

Ammonium Iodide,	120 gr.
Ammonium Bromide,	180 gr.
Syrup of Tolu,	3 fl. oz.
Tincture of Lobelia,	5 fl. oz.

Mix. Teaspoonful every one, two, three, or four hours.

Liniment of Iodide of Ammonium.

Water of Ammonia,	2 fl. oz.
Soap Liniment,	2 fl. oz.
Tincture of Iodine,	8 fl. oz.
Alcohol,	4 fl. oz.

Mix the Soap Liniment with the Tincture of Iodine, and add the Alcohol and Ammonia; shake, and add Alcohol to make 16 fluidounces. Glycerin can be used instead of Soap Liniment.

Elixir Valerianate of Ammonia.

Ammonium Valerianate,	128 gr.
Elixir of Orange (Red),	8 fl. oz.

Dissolve the Valerianate in the Elixir, slightly warmed, and then add a few drops of Water of Ammonia until the solution is neutral and all traces of the valerianic odor disappear.

Solution of Valerianate of Ammonium.

TASTELESS AND ODORLESS.

(Rother's.)

Ammonium Valerianate,	119 gr.
Sodium Borate (Powdered)	191 gr.
Water of Ammonia, sufficient.	
Distilled Water, sufficient to make	8 fl. oz.

Mix the Ammonium Valerianate with 1 fl. oz., of Distilled Water, and add Water of Ammonia, drop by drop, until a clear and slightly alkaline solution is produced; then add 2 fl. oz. of Distilled Water and the Sodium Borate, and when all has dissolved, except the few contaminating crystals of Calcium Borate, add Distilled Water to make 8 fl. oz., and filter.

Elixir of Valerianate of Ammonium with Quinine.

Quinine Sulphate,	32 gr.
Elixir Valerianate of Ammonium,	4 fl. oz.

Mix, and filter if necessary

MAGNESIUM SALTS.

Liquor Magnesii Acetatis. SOLUTION OF ACETATE OF MAGNESIUM.

(Neynaber's.)

Calcined Magnesia,	126 gr.
Acetic Acid, sufficient to saturate.	
Syrup of Citric Acid,	2 fl. oz.
Potassium Bicarbonate,	40 gr.
Water, to make	12 fl. oz.

Made and used like Solution of Magnesium Citrate (see page 521).

Magnesia Mixture.

(Dr. Isaac Remington's.)

Magnesia (Husband's),	90 gr.
Blue Mass,	30 gr.
Aromatic Spirit of Ammonia,	2 fl. dr.
Sugar,	60 gr.
Peppermint Water,	2 fl. oz.
Lime-Water,	3 fl. oz.

Mix. A tablespoonful every two hours.

CALCIUM SALTS.

Chalk Mixture.

(Richard's.)

Precipitated Calcium Carbonate,	1 oz. (troy).
Sugar,	1 oz. (troy).
Tincture of Opium,	1 fl. dr.
Spirit of Cinnamon,	15 min.
Compound Tincture of Lavender,	1 fl. oz.
Tincture of Kino,	1 fl. oz.
Water,	3 fl. oz.

Mix.

Syrup of Hypophosphite of Calcium.

(Procter's.)

Calcium Hypophosphite,	2 oz. (troy).
Sugar,	24 oz. (troy).
Tincture of Vanilla,	1 fl. oz.
Water,	19 fl. oz.

Dissolve the salt in the Water, filter, add the Sugar, dissolve by aid of heat, and add the Tincture. Dose, a teaspoonful to a tablespoonful three times a day.

Syrup of Phosphate of Calcium.

(Wiegand's.)

Precipitated Calcium Phosphate,	1 oz. (troy).
Hydrochloric Acid,	4 fl. dr.
Sugar,	12 oz. (troy).
Water,	7 fl. oz.

Dissolve the Calcium Phosphate, previously mixed with an ounce of Water, by means of the Acid, and filter; add the Sugar, then the remaining Water, until the bulk is increased to 12 fl. oz., and strain. Dose, a teaspoonful.

Aromatic Chalk Powder.

(Ph. Br.)

Cinnamon,	2 oz. (troy).
Nutmeg, Saffron, of each,	1½ oz. (troy).
Cloves,	360 gr.
Cardamom,	240 gr.
Sugar,	12½ oz. (troy).
Prepared Chalk,	5½ oz. (troy).

Reduce to a powder, and mix thoroughly; then pass through a fine sieve, and finally rub it lightly in a mortar.

Chalk Ointment.

Prepared Chalk,	120 gr.
Olive Oil,	90 min.
Lard,	270 gr.

Mix.

Chalk Powders.

Prepared Chalk,	180 gr.
Acacia,	60 gr.
Sugar,	60 gr.
Cinnamon (Powdered),	15 gr.

Mix, and divide into 12 powders.

Potter's Powder.

Prepared Chalk,	3 oz. (troy).
Powdered Camphor,	240 gr.
Ammonium Carbonate,	1 oz. (troy).

Mix.

BARIUM SALTS.

Liquor Barii Chloridi. *U. S.* 1870. Solution of Chloride of Barium.

Chloride of Barium,	1 oz. (troy).
Distilled Water,	3 fl. oz.

Dissolve the Chloride in the Distilled Water, and filter through paper.

ZINC SALTS.

Ceratum Zinci Carbonatis. *U. S.* 1870. Cerate of Carbonate of Zinc.

Precipitated Carbonate of Zinc,	2 oz. (troy).
Ointment,	10 oz. (troy).

Mix them thoroughly.

Canquoin's Paste.

Fused Zinc Chloride,	300 gr.
Wheat Flour,	420 gr.
Alcohol,	1 fl. dr.

Rub the Chloride of Zinc to a fine powder, and make a paste with the Alcohol; then add the Wheat Flour, using strong pressure with the pestle. When the paste is homogeneous, spread with a roller into sheets about one-eighth of an inch thick, and, after a few hours' exposure, preserve in well-corked bottles.

Chloride of Zinc Paste.

(Latour's.)

Zinc Chloride,	300 gr.
Zinc Nitrate,	600 gr.
Water,	1 fl. oz.

Dissolve with the aid of heat, and when cool add to each ounce 300 gr. of Wheat Flour. Make a paste, and then roll into sheets one-eighth of an inch thick. Preserve in well-stoppered bottles.

Calamine Lotion.

(Dr. Tilbury Fox's.)

Levigated Calamine,	40 gr.
Zinc Oxide,	20 gr.
Glycerin,	20 min.
Rose Water,	1 fl. oz.

Mix.

Solution of Sulphide of Zinc.

(Dr. Duhring's.)

Zinc Sulphate,	30 gr.
Potassium Sulphide,	30 gr.
Alcohol,	3 fl. dr.
Rose Water,	3½ fl. oz.

Mix. Used for lupus.

Injection for Gonorrhœa.

Zinc Sulphate,	15 gr.
Lead Acetate,	30 gr.
Extract of Opium,	5 gr.
Tannin,	2 gr.
Rose Water,	3 fl. oz.

Mix, and dispense without filtering.

Villate's Solution.

Zinc Sulphate,	2 oz. (av.).
Copper Sulphate,	2 oz. (av.).
Solution of Subacetate of Lead,	4 fl. oz.
Wine Vinegar,	26 fl. oz.

Mix. Astringent and escharotic. Used in veterinary practice.

Eye-Water.

(Thomas's.)

Zinc Sulphate,	20 gr.
Sodium Chloride,	20 gr.
Rose Water,	1 fl. oz.

Mix.

ALUMINIUM SALTS.

Diarrhœa Powders.

Powdered Alum,	240 gr.
Powdered Kino,	60 gr.
Powdered Opium,	8 gr.

Mix, and divide into 12 powders. For use in obstinate cases. Dose, one every two or three hours.

Nipple Wash.

(Dr. Thomas's.)

Alum,	1 oz. (troy).
Tincture of Galls,	1 fl. oz.

Triturate together, and dispense without straining or filtering.

Gargle of Alum.

Alum,	120 gr.
Honey,	1 fl. oz.
Infusion of Flaxseed,	3 fl. oz.

Make a gargle.

Burrow's Solution.

Lead Acetate,	600 gr.
Alum,	360 gr.
Sodium Sulphate,	60 gr.
Water,	10 fl. oz.

Dissolve the Lead Acetate in 3 fl. oz. of Water, and the Sodium Sulphate and Alum in the remaining Water; mix the solutions and stir; allow it to stand for two days, and filter without washing the residue.

Bromo-Chloralum.

Aluminium Chloride,	1 oz. (troy).
Aluminium Bromide,	240 gr.
Boiling Water,	8 fl. oz.

Dissolve by heat in a water-bath; when cool, filter through paper.

MANGANESE SALTS.

Syrup of Iodide of Manganese.

(Procter's.)

Manganese Sulphate,	1 oz. (troy).
Potassium Iodide,	285 gr.
Sugar,	6 oz. (av.).
Water,	
Syrup, of each, sufficient.	

Dissolve the Sulphate and Iodide, each, in 1½ fl. oz. of cold Water, to which 1 fl. dr. of Syrup has been added. Mix them in a glass-stoppered bottle, and, after the crystals of Potassium Sulphate cease to precipitate, throw the solution on a filter of fine muslin, and allow it to pass into an 8 oz. bottle containing the Sugar; add sufficient Water to the filter to bring up the measure of the resulting Syrup to exactly 8 fl. oz. This contains about 60 gr. of the Iodide to each fl. oz. Dose, 10 minims.

Syrup of Phosphate of Manganese.

(Wiegand's.)

Manganese Sulphate (Cryst.),	785 gr.
Sodium Phosphate,	1200 gr.
Hydrochloric Acid,	4 fl. dr.
Sugar,	10 oz. (troy).
Water, sufficient.	

Dissolve the salts separately, each in 8 fl. oz. of Water, and add the solution of Sodium Phosphate to the solution of Manganese Sulphate, as long as it produces a precipitate, which wash with cold Water and dissolve by means of the Acid; dilute till it measures 7 fl. oz., then add the Sugar. Each fl. dr. contains 5 gr. of the salt.

IRON SALTS.

Bitter Tincture of Iron.

(Physick's.)

Iron (filings),	3 oz. (av.).
Ginger (bruised),	
Gentian (bruised), of each,	1 oz. (av.).
Orange Peel,	½ oz. (av.).
Strong Old Cider,	16 fl. oz.

Macerate for two weeks or longer, express, and filter.

Lemonade Iron.

(Goodell's.)

Tincture of Chloride of Iron,	2 fl. dr.
Diluted Phosphoric Acid,	6 fl. dr.
Spirit of Lemon,	2 fl. dr.
Syrup, sufficient to make	6 fl. oz.

Mix. A dessertspoonful in water after meals.

Iron Pills.

Reduced Iron,	100 gr.
Manna,	30 gr.
Glucose, sufficient.	

Make a mass, and divide into 50 pills.

Mixture of Iron and Conium.

(Dr. King's Am. Disp.)

Precipitated Carbonate of Iron,	300 gr.
Inspissated Juice of Conium,	150 min.
Sugar,	1 oz. (av.).
Oil of Cinnamon,	6 min.
Oil of Gaultheria,	6 min.
Tincture of Tolu,	3 fl. oz.
Madeira Wine,	4 fl. oz.
Water,	4 fl. oz.

Mix together, and allow to stand for a week, when it will be ready for use.

Mixture of Gentian and Iron.

(Meigs's.)

Citrate of Iron and Ammonium,	60 gr.
Sugar,	1½ oz. (troy).
Fluid Extract of Gentian,	80 min.
Compound Tincture of Lavender,	1 fl. oz.
Alcohol,	4 fl. dr.
Water, sufficient to make	8 fl. oz.

Mix the fluid extract with 1 fl. oz. of Water and add the Compound Tincture of Lavender; treat this with hydrated oxide of iron, and, having filtered it, mix with the other ingredients, and filter.

Grisolle's Pills.

Alcoholic Extract of Nux Vomica,	4 gr.
Iron Phosphate,	46 gr.
Extract of Quassia,	31 gr.
Extract of Gentian, sufficient.	

Mix, and make into 25 pills. One pill three times a day, in conjunction with cold hip-baths, and abstention from drink during the evening. Used for incontinence of urine.

Elixir of Iron, Quinine, and Strychnine.

Strychnine,	2 gr.
Quinine,	64 gr.
Iron Pyrophosphate,	128 gr.
Alcohol,	2 fl. oz.
Water,	3 fl. oz.
Syrup,	3 fl. oz.
Elixir of Orange,	8 fl. oz.

Dissolve the Strychnine and afterwards the Quinine in the Alcohol. Dissolve the Pyrophosphate of Iron in the Water. Mix the two solutions, and add the Syrup and the Elixir. Filter if necessary.

Elixir of Pyrophosphate of Iron.

Iron Pyrophosphate,	256 gr.
Elixir of Orange,	16 fl. oz.

Dissolve and filter.

Mixture of Iron and Conium.

(Tully's.)

Iron Subcarbonate,	600 gr.
Extract of Conium,	300 gr.
Sugar,	8 oz. (troy).
Oil of Cassia,	18 min.
Oil of Gaultheria,	20 min.
Compound Tincture of Cinnamon,	2 fl. oz.
Tincture of Tolu,	4 fl. dr.
Water, sufficient to make	16 fl. oz.

Mix thoroughly.

Compound Iron Pills.

(Thomson's.)

Iron Subcarbonate,	60 gr.
Extract of Conium,	60 gr.

Mix, and divide into 24 pills.

Startin's Mixture.

Iron Sulphate,	60 gr.
Magnesium Sulphate,	1 oz. (troy).
Tincture of Gentian,	1 fl. oz.
Diluted Sulphuric Acid,	4 fl. dr.
Water,	3 fl. oz.

A teaspoonful to be taken after eating.

Tonic Laxative.

(Dr. C. H. Thomas.)

Powdered Aloes,	24 gr.
Dried Iron Sulphate,	24 gr.
Alcoholic Extract of Hyoscyamus,	6 gr.
Extract of Nux Vomica,	6 gr.
Oleoresin of Capsicum,	4 gr.

Make into a mass, and divide into 24 pills.

Blaud's Pills.

Dried Iron Sulphate,	276 gr.
Potassium Carbonate,	276 gr.
Powdered Tragacanth,	30 gr.
Glycerin, sufficient.	

Make into 144 pills.

Emmenagogue Pills.

(Dr. Otto's.)

Dried Iron Sulphate,	48 gr.
Powdered Aloes,	12 gr.
Turpentine,	32 gr.
Oil of Turpentine,	10 min.

Make a mass, and divide into 30 pills. Dose, two, three times a day.

NICKEL SALTS.

Syrup of Bromide of Nickel.

(Dr. Da Costa's.)

Nickel Bromide,	160 gr.
Glycerin,	4 fl. dr.
Sugar,	8 oz. (av.).
Water,	4 fl. oz.

Dissolve the Nickel Bromide in the Water, and add the Glycerin. Make a syrup by cold percolation or agitation.

Pills of Bromide of Nickel.

(Dr. Da Costa's.)

Nickel Bromide,	60 gr.
Powdered Althæa,	6 gr.
Extract of Gentian,	6 gr.
Alcohol, sufficient.	

Mix, and make into 12 pills.

LEAD SALTS.

Pills of Acetate of Lead.

(University College, London.)

Lead Acetate,	12 gr.
Morphine Hydrochlorate,	6 gr.
Extract of Hyoscyamus,	48 gr.

Make a mass, and divide into 24 pills.

Compound Cerate of Lead.

(J. Parrish, Sr.)

Cerate of Subacetate of Lead,	240 gr.
Cerate,	240 gr.
Powdered Opium,	60 gr.
Mild Chloride of Mercury,	60 gr.

Mix. Used in eruptions of a local character.

Judkin's Ointment.

Lead Acetate,	360 gr.
Lead Oxide (Red),	1 oz. (troy).
Sodium Borate,	60 gr.
Oil of Turpentine,	15 min.
Olive Oil,	2 fl. dr.
Linseed Oil,	4 fl. oz.

Boil the first two oils together for four hours, remove from the fire, add, with stirring, the Lead Oxide, Sodium Borate, and Lead Acetate; when nearly cool, add the Turpentine.

Glycerole of Subacetate of Lead.

(Dr. Balmanno Squire.)

Lead Acetate,	1 oz. (troy).
Lead Oxide,	336 gr.
Glycerin,	4 fl. oz.

Mix, and expose for some time to a temperature of 176.6° C. (350° F.). Filter through paper in a hot-water funnel.

Diarrhœa Pills.

(Prof. William Thompson's.)

Lead Acetate,	16 gr.
Powdered Camphor,	12 gr.
Powdered Opium,	8 gr.
Bismuth Subcarbonate,	12 gr.
Extract of Gentian, sufficient.	

Mix, and make into 12 pills.

Logan's Plaster.

Lead Oxide,	2 oz. (av.).
Lead Carbonate,	2 oz. (av.).
Soap,	1½ oz. (av.).
Fresh Butter,	240 gr.
Olive Oil,	5 fl. oz.
Powdered Mastic,	20 gr.

Mix the Soap, Oil, and Butter together, then add the Lead Oxide, and boil it gently over a slow fire for an hour and a half, or until it has a pale brown color, stirring constantly; the heat may then be increased, and the boiling continued, till a portion of the melted plaster, being dropped on a smooth board, is found not to adhere; then remove it from the fire, and add the mastic.

Mother's Salve.

(Emplastrum Fuscum. Onguent de la Mère.)

Lead Oxide,	60 gr.
Burgundy Pitch,	12 gr.
Yellow Wax,	60 gr.
Mutton Tallow,	60 gr.
Lard,	60 gr.
Olive Oil,	120 gr.
Butter,	60 gr.

Place the fatty substances in a suitable vessel, and heat them until they begin to smoke; then add the Lead Oxide in small portions, constantly stirring the mass with a wooden spatula. Keep the mixture over the fire, constantly agitating, until it acquires a brown color, then mix in the Pitch and pour into moulds.

COPPER SALTS.

Cauterizing Pencils of Sulphate of Copper.

Copper Sulphate,	240 gr.
Sodium Borate,	60 gr.

Triturate together in a warm mortar; the mass becomes soft from the liberation of water of crystallization and it may be readily rolled into sticks. If it becomes too dry, a little water may be added.

Metz's Balsam.

Powdered Aloes,	120 gr.
Verdigris,	180 gr.
Zinc Sulphate,	90 gr.
Turpentine,	2 oz. (troy).
Oil of Juniper,	4 fl. oz.
Oil of Cloves,	1 fl. dr.
Oil of Laurel Berries,	1 fl. oz.
Olive Oil,	4½ fl. oz.
Linseed Oil,	4½ fl. oz.

Melt the Turpentine, Olive Oil, Linseed Oil, and Oil of Laurel Berries by a gentle heat, and add the Aloes, Verdigris, and Zinc Sulphate. Pour into a bottle, and add the Oil of Juniper and Cloves, shaking well. Used as a dressing for ulcers, etc.

SILVER SALTS.

Pills of Nitrate of Silver.

Nitrate of Silver,	20 gr.
Powdered French Chalk,	80 gr.
Petrolatum, q. s.	

Make a mass, and divide into 40 pills.

MERCURY SALTS.

Mercurial Plaster.

(De Vigo's.)

Lead Plaster,	2000 gr.
Yellow Wax,	100 gr.
Resin,	100 gr.
Powdered Olibanum,	80 gr.
Ammoniac,	30 gr.
Powdered Bdellium,	30 gr.
Powdered Myrrh,	30 gr.
Powdered Saffron,	20 gr.
Mercury,	600 gr.
Turpentine,	100 gr.
Storax,	300 gr.
Oil of Lavender,	10 gr.

Mix.

Scott's Ointment.

Strong Mercurial Ointment,	1 oz. (troy).
Soap Cerate,	1 oz. (troy).
Powdered Camphor,	60 gr.

Mix.

Compound Ointment of Mercury.

Mercurial Ointment,	120 gr.
Ointment of Belladonna,	120 gr.
Iodine Ointment,	120 gr.

Mix.

Van Swieten's Solution.

(Solution Antisyphilitique de Van Swieten. Liqueur d'Oxymuriate de Mercure.)

Corrosive Chloride of Mercury,	15 gr.
Alcohol (80 per cent.),	3½ fl. oz.
Distilled Water, sufficient to make	32 fl. oz.

A tablespoonful contains nearly ¼ grain of Corrosive Chloride of Mercury.

Liniment of Mercury.

Liniment of Camphor,	1 fl. oz.
Tincture of Quillaia,	3 fl. oz.
Stronger Water of Ammonia,	160 min.
Water,	140 min.
Mercurial Ointment,	1 oz. (troy).

Mix.

Corrosive Sublimate Gauze.

Corrosive Chloride of Mercury,	2 gr.
Glycerin,	50 min.
Water,	1 fl. oz.

Immerse bleached absorbent muslin in this solution for about twelve hours; then wring it out, and allow it to dry as far as the Glycerin will permit.

Aqua Phagedænica.

(Lotio Flava. Yellow Wash.)

Corrosive Chloride of Mercury,	8 gr.
Solution of Lime,	4 fl. oz.

Mix.

Palmer's Lotion.

Corrosive Chloride of Mercury,	4 gr.
Alum,	6 gr.
Water,	8 fl. oz.

Dissolve. For external use.

Calomel and Jalap Powder.

Mild Chloride of Mercury,	10 gr.
Powdered Jalap,	20 gr.

Mix. To be given at a dose.

Tetter Ointment.

(Dr. S. G. Morton.)

Alum,	120 gr.
Lead Carbonate,	120 gr.
Calomel,	120 gr.
Oil of Turpentine,	2 fl. dr.
Ointment,	1½ oz. (troy).

Triturate the powders together till they are impalpable and thoroughly mixed; then incorporate them with the Oil and Ointment.

Lotio Nigra. (Black Wash.)

Mild Chloride of Mercury,	15 gr.
Solution of Lime,	4 fl. oz.

Mix.

Townsend's Mixture.

(N. Y. Hosp.)

Red Iodide of Mercury,	1 gr.
Potassium Iodide,	300 gr.
Syrup of Orange Peel,	2 fl. oz.
Compound Tincture of Cardamom,	2 fl. dr.
Water, sufficient to make	4 fl. oz.

Mix. Dose, 1 to 4 teaspoonfuls.

Syrup of Iodohydrargyrate of Iron.

Red Iodide of Mercury,	1 gr.
Syrup of Iodide of Iron,	4 fl. oz.

Mix. Dose, 20 to 30 minims, as an alterative tonic.

Unguentum Hydrargyri Iodidi Rubri. *U. S.* 1870. Ointment of Red Iodide of Mercury.

Red Iodide of Mercury, in fine powder,	16 gr.
Simple Ointment,	1 oz. (av.).

Mix thoroughly.

Syrup of Iodohydrargyrate of Potassium. (Sirop Gibert.)

Red Iodide of Mercury,	5 gr.
Potassium Iodide,	260 gr.
Distilled Water,	6 fl. dr.
Syrup, sufficient to make	16 fl. oz.

Dose, 1 teaspoonful.

Compound Pills of Iodide of Mercury.

Green Iodide of Mercury,	10 gr.
Guaiac Resin,	40 gr.
Extract of Gentian,	30 gr.

Triturate the Guaiac Resin into a mass with a little Alcohol; then incorporate with it the Extract and Iodide of Mercury, and divide into 20 pills.

Cream for Chilblains.

(Vance's.)

Nitrate of Mercury Ointment,	1 oz. (troy).
Camphor,	60 gr.
Oil of Turpentine,	2 fl. dr.
Olive Oil,	4 fl. dr.

Mix well. To be applied with gentle friction before the chilblains break.

ANTIMONY SALTS.

Antimonial and Saline Mixture.

(Prof. Gross's.)

Antimony and Potassium Tartrate,	2½ gr.
Magnesium Sulphate,	2 oz. (troy).
Morphine Sulphate,	1½ gr.
Aromatic Sulphuric Acid,	30 min.
Tincture of Veratrum Viride,	90 min.
Syrup of Ginger,	2 fl. oz.
Distilled Water,	10 fl. oz.

Mix. Average dose, a tablespoonful; to be diminished in case of vomiting or much nausea.

Antimonial Powder.

(Tyson's.)

Antimony Oxide,	20 gr.
Calcium Phosphate,	180 gr.

Mix. Dose, 5 to 10 grains.

Unguentum Antimonii. *U. S.* 1870.

Antimonial Ointment.

Tartrate of Antimony and Potassium,	100 gr.
Lard,	400 gr.

Rub the Tartrate of Antimony and Potassium with the Lard, gradually added, until they are thoroughly mixed.

Emplastrum Antimonii. *U. S.* 1870.

ANTIMONIAL PLASTER.

Tartrate of Antimony and Potassium, in fine powder, 1 oz. (troy).
Burgundy Pitch, 4 oz. (troy).

Melt the Pitch by means of a water-bath, and strain; then add the powder, and stir them well together until the mixture thickens on cooling.

ARSENIC SALTS.

Solution of Arsenite of Sodium.

(Harle's Solution.)

Arsenious Acid,	15 gr.
Sodium Carbonate (Exsiccated),	15 gr.
Cinnamon Water,	1 fl. oz.
Distilled Water, sufficient to make	4 fl. oz.

Boil the solids with 3 fl. oz. of Distilled Water until they are dissolved, make up the measure of 3 fl. oz. with Distilled Water, and add the Cinnamon Water. Dose, 4 minims.

Solution of Bromide of Arsenic.

(Clemens's.)

Arsenious Acid,	80 gr.
Potassium Carbonate,	80 gr.
Bromine,	160 gr.
Distilled Water,	15½ oz.

Boil the Potassium Carbonate and the Acid with most of the Water until dissolved; when cold, add the Bromine, and Water enough to make the prescribed quantity. It is said to improve by age, owing to the combination of the Bromine. Dose, 1 to 4 drops, in water, once or twice daily.

Solution of Arsenic Chlorophosphide.

Arsenious Acid,	4 gr.
Phosphorus,	8 gr.
Diluted Hydrochloric Acid,	12 gr.
Water, sufficient to make	18 fl. oz.

Mix. Digest on a water-bath for twenty-four hours, and decant the supernatant liquid.

Solution of Arseniate of Ammonium.

(Biette's Arsenical Solution.)

Arseniate of Ammonium,	2 gr.
Distilled Water,	2 fl. oz.

Mix. Dose, 20 drops.

Solution of Arseniate of Sodium.

(Pearson's.)

Arseniate of Sodium (Cryst.),	3 gr.
Distilled Water,	4 fl. oz.

Dissolve. Dose, 20 drops. This solution must not be confounded with the officinal Liquor Sodii Arseniatis, which is six times the strength of Pearson's solution (see page 627).

Painless Caustic.

(Esmarch's.)

Arsenious Acid,	2 gr.
Morphine Sulphate,	2 gr.
Mild Chloride of Mercury,	16 gr.
Powdered Acacia,	96 gr.

Mix.

BISMUTH SALTS.

Oxide of Bismuth Ointment.

(McCall Anderson.)

Bismuth Oxide,	50 gr.
Oleic Acid,	1 fl. oz.
White Wax,	150 gr.
Vaseline,	1 oz. (troy).
Oil of Rose,	1 min.

Mix.

Carbonate of Bismuth Mixture.

Bismuth Subcarbonate,	120 gr.
Cinnamon Water,	2 fl. oz.
Syrup of Acacia,	2 fl. oz.

Mix them. A teaspoonful for infants in cholera infantum.

Elixir of Bismuth.

Citrate of Bismuth and Ammonium,	128 gr.
Elixir of Orange,	7½ fl. oz.
Water,	4 fl. dr.

Dissolve the salt in the Water with the aid of a few drops of Water of Ammonia, and then add the Elixir.

Glycerole of Nitrate of Bismuth.

Nitrate of Bismuth (Cryst.),	120 gr.
Glycerin,	1 fl. oz.

Dissolve the Nitrate of Bismuth in the Glycerin, without heat.

Bismuth Catarrh Snuff.

Bismuth Subnitrate,	360 gr.
Morphine Hydrochlorate,	2 gr.
Acacia,	120 gr.

Mix.

UNOFFICINAL PREPARATIONS OF ORGANIC SUBSTANCES.

CELLULIN.

Aromatic Vinegar.

Glacial Acetic Acid,	
Oil of Cloves,	
Camphor,	of each, 1 fl. oz.

Mix.

Wine of Tar.

Tar,	8 fl. oz.
Lager Beer,	8 pints.
Alcohol,	8 fl. oz.

Boil the Tar with the Beer for fifteen minutes, allow to cool, add the Alcohol, and filter.

Camphorated Acetic Acid.

Camphor,	1 oz. (av.).
Acetic Acid,	16 fl. oz.

Powder the Camphor with the aid of alcohol, and dissolve it in the Acetic Acid.

Raspberry Vinegar.

Raspberry Syrup,	16 fl. oz.
Glacial Acetic Acid,	1 fl. dr.

Mix. Dilute with sufficient water.

Acetone Mixture.

(Dr. W. L. Atlee.)

Acetone,	1 fl. dr.
Camphorated Tincture of Opium,	1 fl. oz.
Wine of Antimony,	1 fl. oz.
Wine of Tar,	2 fl. oz.

Mix. Dose, a teaspoonful.

Glyceritum Picis Liquidæ. *U. S.* 1870.
GLYCERITE OF TAR.

Tar,	1 oz. (troy).
Carbonate of Magnesium,	2 oz. (troy).
Glycerin,	4 fl. oz.
Alcohol,	2 fl. oz.
Water, a sufficient quantity.	

Triturate the Tar with the Magnesium Carbonate, and then with portions of a mixture of the Alcohol, Glycerin, and 10 fl. oz. of Water; express the liquid, put the residue in a percolator, and displace first with the expressed liquid, and afterwards with Water, until 16 fl. oz. of percolate are obtained.

Infusum Picis Liquidæ. *U. S.* 1870.
INFUSION OF TAR. (TAR WATER.)

Tar,	4 oz. (troy).
Water,	16 fl. oz.

Mix them, and shake the mixture frequently during twenty-four hours; then pour off the infusion, and filter through paper.

Alkaline Solution of Tar.

(Dr. L. D. Bulkley.)

Tar,	2 fl. dr.
Potassa,	60 gr.
Distilled Water,	5 fl. dr.

Mix.

Carbolate of Iodine.

(Dr. Holtz's formula.)

Carbolic Acid (Cryst.),	60 gr.
Alcohol,	1 fl. dr.
Tincture of Iodine,	4 fl. dr.
Water,	5 fl. dr.

Mix.

Aqua Acidi Carbolici. *U. S.* 1870.
CARBOLIC ACID WATER.

Glycerite of Carbolic Acid,	5 fl. dr.
Water, a sufficient quantity to make	8 fl. oz.

Mix the Glycerite with the Water. Used as a gargle, and as a wash in various skin-diseases.

Glycerite of Birch Tar.

Birch Tar,	1 oz. (troy).
Glycerin,	8 fl. oz.

Dilute the Glycerin with one-fifth of its volume of water, and mix.

Unguentum Creasoti. *U. S.* 1870.
OINTMENT OF CREASOTE.

Creasote,	1 fl. dr.
Lard,	2 oz. (troy).

Mix thoroughly.

Dobell's Solution.

Carbolic Acid,	45 min.
Sodium Borate,	60 gr.
Sodium Bicarbonate,	60 gr.
Glycerin,	1 fl. oz.
Water, sufficient to make	16 fl. oz.

Glyceritum Acidi Carbolici. *U. S.* 1870.
GLYCERITE OF CARBOLIC ACID.

Carbolic Acid,	2 oz. (troy).
Glycerin,	8 fl. oz.

Rub them together in a mortar until the Acid is dissolved.

Carbolized Jute.

Carbolic Acid (Cryst.),	850 gr.
Paraffin,	850 gr.
Resin,	1400 gr.
Benzin,	24 fl. oz.

Make a solution and saturate 16 oz. of jute with it.

Collodion for Corns.

(Gezow's.)

Salicylic Acid,	45 gr.
Extract of Indian Hemp,	8 gr.
Collodion,	6 fl. dr.

Dissolve.

Salicylic Mixture.

(Thiersch's.)

Salicylic Acid,	80 gr.
Syrup of Orange Peel,	2 fl. oz.
Alcohol,	3 fl. oz.
Water, sufficient to make	10 fl. oz.

Mix. Dose, a teaspoonful.

Salicylic Acid Cotton.

Purified Cotton,	600 gr.
Salicylic Acid,	60 gr.
Alcohol,	10 fl. dr.
Glycerin,	6 min.

Dissolve the Salicylic Acid in the Alcohol, add the Glycerin to this solution, and saturate the Cotton with the liquid; press out the superfluous liquid, and dry.

Charcoal and Blue Mass Mixture.

Sodium Bicarbonate,	30 gr.
Charcoal,	60 gr.
Mass of Mercury,	8 gr.
Aromatic Syrup of Rhubarb,	2 fl. oz.
Water,	2 fl. oz.

Triturate together into a uniform mixture. Dose, a tablespoonful.

Liebig's Corn Collodion.

Salicylic Acid,	5 gr.
Extract of Indian Hemp,	30 gr.
Collodion,	5 fl. dr.

Mix and dissolve.

Charcoal Poultice.

(Thomsonian name.)

Charcoal,	1 oz. (troy).
Ginger,	
Bayberry, of each,	240 gr.
Elm,	1 oz. (troy).
Hot Water, sufficient.	

Mix.

Naphthol Ointment.

(Hardy's.)

Naphthol,	120 gr.
Vaseline,	2½ oz. (troy).

Dissolve the Naphthol in half its weight of Ether; mix this solution with a portion of the Vaseline, and heat to about 40° C. (104° F.) until the Ether is completely evaporated; then add the remainder of the Vaseline, and triturate thoroughly; finally, preserve the ointment in a well-covered vessel.

Naphthol Salve.

(Kaposi's.)

Naphthol,	180 gr.
Green Soap,	600 gr.
Prepared Chalk,	120 gr.
Lard,	2½ oz. (av.).

Mix. Used in itch. The affected part to be rubbed twice a day.

AMYLACEOUS AND MUCILAGINOUS SUBSTANCES.

Soluble Iodide of Starch.

Iodine,	360 gr.
Starch,	6 oz. (troy).
Ether,	10 fl. dr.

Dissolve the Iodine in the Ether, pour the solution over the Starch; then triturate till the Ether is evaporated; introduce into a water-bath, and continue the heat for half an hour with occasional stirring. A portion of the Iodine vapor has escaped, but the Starch, which has now become soluble, will be combined with about 4 per cent. of Iodine.

Decoctum Hordei. *U.S.* 1870. Decoction of Barley.

Barley,	240 gr.
Water, sufficient.	

Having washed away extraneous matters which adhere to the Barley, boil it with 2 fl. oz. of Water for a short time, and throw away the resulting liquid; then, having poured on it 16 fl. oz. of boiling Water, boil down to 8 fl. oz., and strain.

Syrup of Iodide of Starch.

Iodide of Starch (soluble),	360 gr.
Sugar,	19 oz. (troy).
Water,	12 fl. oz.

Dissolve the Iodide in the Water, and add the Sugar. This syrup contains 1 part of Iodine in 1000. Dose, a teaspoonful.

Conserve of Hollyhock.

(Thomsonian name.)

Poplar Bark,	120 gr.
Bayberry,	120 gr.
Hydrastis,	120 gr.
Cloves,	120 gr.
Cinnamon,	120 gr.
Cypripedium,	120 gr.
Capsicum,	60 gr.
Oil of Pennyroyal,	1 fl. dr.
Hollyhock Flowers,	4 oz. (troy).

Pound, and form into balls of the size of small marbles.

Infusum Lini Compositum. *U.S.* 1870. Compound Infusion of Flaxseed.

Flaxseed,	½ oz. (troy).
Glycyrrhiza (bruised),	120 gr.
Boiling Water,	16 fl. oz.

Macerate for two hours in a covered vessel, and strain.

SACCHARINE SUBSTANCES.

Syrup of Manna.

Manna,	1 oz. (troy).
Sugar,	5 oz. (troy).
Water,	4 fl. oz.

Dissolve the Manna in the Water, filter, add the Sugar, and heat to boiling, then strain.

Syrup of Liquorice Root.

Fluid Extract of Glycyrrhiza,	4 fl. oz.
Syrup, a sufficient quantity to make	16 fl. oz.

Mix.

Pectoral Lozenges.

(Dr. Jackson's.)

Powdered Ipecac,	5 gr.
Sulphurated Antimony,	2½ gr.
Morphine Hydrochlorate,	3 gr.
Powdered Acacia,	330 gr.
Powdered Sugar,	330 gr.
Powdered Extract of Glycyrrhiza,	330 gr.
Oil of Sassafras,	2 min.
Tincture of Tolu,	2 min.

To be made into a stiff mass with Simple Syrup, and divided into 100 lozenges, or into lozenges of 10 gr. each. Each lozenge contains $\frac{1}{10}$ gr. of Ipecac, $\frac{1}{10}$ gr. of Antimony, $\frac{1}{33}$ gr. of Morphine. One every three or four hours.

Cough Powder.

(Thomsonian name.)

Lobelia,
Glycyrrhiza,
Skunk Cabbage,
Sugar, of each, 1 oz. (troy).
Mix.

Aromatic Elixir of Glycyrrhiza.

Fluid Extract of Glycyrrhiza,	2 fl. oz.
Alcohol,	4 fl. oz.
Syrup,	6 fl. oz.
Oil of Cloves,	10 min.
Oil of Cinnamon,	5 min.
Oil of Nutmeg,	12 min.
Water, sufficient to make	16 fl. oz.

Mix.

Pectoral Powder.

(Wedel's.)

Benzoic Acid,	8 gr.
Washed Sulphur,	75 gr.
Glycyrrhiza,	250 gr.
Iris,	30 gr.
Sugar,	300 gr.
Oil of Anise,	4 min.
Oil of Fennel,	4 min.

Mix. A tablespoonful three or four times a day in bronchitis, severe cough, or croup.

DERIVATIVES OF SUGARS THROUGH THE ACTION OF FERMENTS.

Alcoholic Mixture.

(Gubler's.)

Alcohol (85 per cent.),
Water,
Syrup of Orange, of each, 2 fl. oz.

A tablespoonful to be given every two hours.

Solution of Butyl-Chloral.

(CROTON-CHLORAL.)

Butyl-Chloral,	7 gr.
Alcohol,	30 min.
Distilled Water,	2½ fl. oz.
Syrup of Orange,	2 fl. oz.

Mix. A tablespoonful every two hours.

Camphorated Chloro-tannate of Iodine.

Chloral,	60 gr.
Iodine,	30 gr.
Oil of Camphor,	6 fl. dr.
Tannic Acid, sufficient.	

Dissolve, and add sufficient Tannic Acid to bring the mixture to the consistence of thick syrup.

Glycerole of Chloral and Camphor.

(C. Pavesi.)

Camphor (in powder),	75 gr.
Chloral,	60 gr.
Oil of Juniper,	30 min.
Glycerin,	4 fl. dr.
Alcohol,	5 fl. dr.

Mix in a vial, and expose to a gentle heat (not over 40° C. = 104° F.) until solution has been effected. Let cool, and keep the vial well stoppered.

Chloral Cream.

Chloral,	300 gr.
Sugar,	1½ oz. (troy).
Water,	15 fl. dr.

Dissolve the Chloral in the Water, and triturate with the Sugar in a mortar.

Elixir of Chloroform.

Chloroform,	6 fl. dr.
Oil of Cinnamon,	10 min.
Tincture of Opium,	
Tincture of Camphor,	
Aromatic Spirit of Ammonia, of each,	6 fl. dr.
Brandy,	1 fl. oz.

Mix. Dose, half a teaspoonful.

Gelatinized Chloroform.

Purified Chloroform,	6 fl. dr.
White of Egg,	6 fl. dr.

Put into a wide-mouth two-ounce vial, shake it, and allow it to stand for three hours.

Chloroform Emulsion.

Purified Chloroform,	40 min.
Tincture of Quillaia,	4 fl. dr.
Distilled Water, sufficient to make	4 fl. oz.

Mix.

Elixir of Chloroform.

(Dr. Hartshorn's Chloroform Paregoric.)

Chloroform,	1½ fl. oz.
Tincture of Opium,	1½ fl. oz.
Spirit of Camphor,	1½ fl. oz.
Aromatic Spirit of Ammonia,	1½ fl. oz.
Oil of Cinnamon,	20 min.
Brandy,	2 fl. oz.

Mix. Dose, ½ fl. dr. or less.

Wade's Suppositories.

Iodoform,	60 gr.
Subnitrate of Bismuth,	60 gr.
Chloral,	8 gr.
Morphine,	2½ gr.
Oil of Rose,	10 min.
Oil of Theobroma,	240 gr.

Mix, and divide into 12 suppositories one-eighth of an inch in diameter. One to be inserted into the urethra three times daily.

Iodoform Collodion.

Iodoform,	30 gr.
Balsam of Peru,	30 gr.
Green Soap,	30 gr.
Flexible Collodion, sufficient to make	1 oz. (troy).

Mix. After application cover the parts with gutta-percha tissue.

Carbolized Iodoform.

Iodoform,	150 gr.
Carbolic Acid,	1 min.
Oil of Peppermint,	2 min.

Mix the Iodoform and Acid by trituration, and then add the volatile oil.

Iodoform Paste.

Iodoform,	60 gr.
Mucilage of Acacia,	10 min.
Glycerin,	10 min.
Oil of Peppermint,	1 min.

Mix.

Iodoform Cotton.

Purified Cotton,,	360 gr.
Iodoform,	24 gr.
Ether,	2 fl. dr.
Alcohol,	4 fl. dr.
Glycerin,	2 fl. dr.

Dissolve the Iodoform in the Ether and Alcohol mixed, add the Glycerin to this solution, and saturate the Cotton with this liquid. Let it dry by exposure to the air.

Iodoform Pencils.

Iodoform,
Oil of Theobroma, of each, 31 gr.

Triturate together, and roll the mass into 5 pencils one-twelfth of an inch thick, then dust with lycopodium.

Compound Iodoform Ointment.

(Dr. J. Wm. White's.)

Iodoform,	60 gr.
Oil of Anise,	20 min.
Oil of Rose,	5 min.
Oil of Ylang-Ylang,	5 min.
Ointment of Rose Water,	1 oz. (troy).

Mix.

Compound Iodoform Ointment.

(N. Y. Hosp.)

Iodoform,	
Tannic Acid,	of each, 60 gr.
Vaseline,	1 oz. (troy).

Mix.

Compound Tincture of Iodoform.

Iodoform,	15 gr.
Potassium Iodide,	120 gr.
Glycerin,	2 fl. dr.
Alcohol,	6 fl. dr.

Mix. Rub the Iodoform and the Potassium Iodide in a mortar until a fine powder is produced, then add the Glycerin and rub to the consistency of cream; then add the Alcohol, and stir briskly until all is dissolved. Dose, 15 drops three times a day, on sugar or in syrup.

Elixir of Paraldehyd.

Paraldehyd,	160 min.
Alcohol,	14 fl. dr.
Tincture of Vanilla,	30 min.
Water,	1 fl. oz.
Syrup,	1½ fl. oz.

Dose, 1 to 2 teaspoonfuls.

Liniment of Iodoform.

Iodoform,	80 gr.
Camphor,	80 gr.
Oil of Sassafras,	1 fl. dr.
Expressed Oil of Almond,	4 fl. oz.

Powder the Iodoform and Camphor, introduce into a dry vial, add the oils, and heat in a water-bath, shaking frequently until dissolved.

PRODUCTS OF THE ACTION OF FERMENTS UPON ACID SACCHARINE FRUITS.

Brandy Mixture.

Yolk of Eggs,	2.
Sugar,	240 gr.
Oil of Cinnamon,	2 min.
Cinnamon Water,	4 fl. oz.
Brandy,	4 fl. oz.

Mix. Dose, a tablespoonful as occasion may require.

Potion of Todd.

(Dorvault's.)

Brandy,	6 fl. dr.
Distilled Water,	9 fl. dr.
Syrup,	4 fl. dr.
Tincture of Canella,	1 fl. dr.

Mix.

Strengthening Syrup.

(Thomsonian name.)

Comfrey Root,	2 oz. (av.).
Inula,	1 oz. (av.).
Marrubium,	240 gr.
Beth Root,	120 gr.
Brandy,	8 fl. oz.
Sugar,	8 oz. (av.).
Water,	3 pints.

Add the Water to the Comfrey Root, Inula, and Marrubium, and boil until the liquid measures 24 fl. oz., then strain, and add the remaining ingredients.

VOLATILE OILS.

Confectio Aurantii Corticis. *U. S.* 1870.

CONFECTION OF ORANGE PEEL.

Sweet Orange Peel, recently separated from the fruit by grating,	6 oz. (troy).
Sugar,	18 oz. (troy).

Beat the Orange Peel with the Sugar, gradually added, until they are thoroughly mixed.

Cardinal Drops, or Bishop Drops.

(TINCTURA EPISCOPALIS.)

Orange Peel,	720 gr.
Orange Berries,	720 gr.
Cloves,	120 gr.
Cinnamon,	120 gr.
Water,	8 fl. oz.
Bitter Almond Water,	2 fl. dr.
Alcohol,	12 fl. oz.

Mix, and macerate seven days.

Red Elixir.

Compound Tincture of Cochineal,	6 fl. dr.
Elixir of Orange,	24 fl. oz.

Mix.

Red Drops.

(Whitwith's.)

Oil of Thyme,	2 fl. dr.
Tincture of Myrrh,	1 fl. oz.
Tincture of Camphor,	1 fl. dr.
Compound Tincture of Lavender,	1 fl. oz.
Alcohol,	4 fl. oz.

Dose, 25 drops in a suitable vehicle, two, three, or four times a day.

Confectio Aromatica. *U. S.* 1870. Aromatic Confection.

Aromatic Powder,	4 oz. (troy).
Clarified Honey,	4 oz. (troy).

Rub the Aromatic Powder with Clarified Honey until a uniform mass of the proper consistence is obtained.

Compound Spirit of Cajuput.

Oil of Cajuput,		
Oil of Cloves,		
Oil of Peppermint,		
Oil of Anise,	of each,	4 fl. dr.
Alcohol,		2 fl. oz.

Mix. A powerful stimulant.

Eucalyptus Gauze.

(Lister's.)

Oil of Eucalyptus,	60 min.
Damar,	180 gr.
Paraffin,	180 gr.

The Damar and Paraffin are melted, the Oil is added, and the mixture sprinkled or squirted over the muslin laid together in folds. It is then placed in an air-tight heating apparatus, compressed by weights, and exposed to a dry heat. The finished gauze contains 10 to 11 per cent. of mixture.

Compound Mixture of Apium.

(Dr. W. A. Hammond's.)

Fluid Extract of Erythroxylon,	2 fl. oz.
Fluid Extract of Viburnum,	1 fl. oz.
Fluid Extract of Celery,	1 fl. oz.

Mix.

Elemi Ointment.

Elemi (Resin),	60 gr.
Cerate,	1 oz. (troy).
Resin Cerate,	120 gr.
Balsam of Peru,	120 min.

Fuse together, and mix thoroughly.

Wine of White Ash.

(Wiegand's.)

White Ash (inner bark),	2 oz. (troy).
White Wine,	4 fl. oz.

Macerate the bark for three days, pack firmly in a cylindrical percolator, and displace slowly 4 fl. oz.

Camphor Mixture.

(Parrish's.)

Sugar,	60 gr.
Compound Tincture of Lavender,	1 fl. oz.
Camphor Water,	3 fl. oz.

Mix. Dose, a tablespoonful every two hours in diarrhœa and cholera morbus, adding 10 drops of laudanum where there is much pain.

Camphor Mixture.

(Hope's.)

Tincture of Opium,	20 min.
Nitrous Acid,	30 min.
Camphor Water,	4 fl. oz.

Mix. Dose, a tablespoonful every two hours in diarrhœa and dysentery.

Croup Liniment.

Camphor,	320 gr.
Oil of Turpentine,	2 fl. oz.

Make a solution.

Carbolated Camphor.

Camphor,	60 gr.
Carbolic Acid,	20 gr.
Alcohol,	2 min.

Mix.

Brassicon.

Camphor,	20 gr.
Oil of Peppermint,	1 fl. dr.
Volatile Oil of Mustard,	12 min.
Ether,	2 fl. dr.
Alcohol,	6 fl. dr.
Spirit of Peppermint, sufficient to color.	

Mix. Used externally in headache.

Cholera Remedy.

(Dr. Dwight's.)

Tincture of Camphor,	1 fl. oz.
Tincture of Opium,	1 fl. oz.
Compound Tincture of Rhubarb,	1 fl. oz.

Mix. Dose, half a teaspoonful.

Camphor Julep.

(Thomsonian name.)

Camphor,	30 gr.
Myrrh,	105 gr.
Sugar,	60 gr.
Water	2 fl. oz.

Cream of Camphor.

Soap,	1½ oz. (troy).
Camphor,	360 gr.
Ammonium Chloride,	1½ oz. (troy).
Water of Ammonia,	1½ fl. oz.
Oil of Turpentine,	6 fl. dr.
Water,	12 fl. oz.

Dissolve the Soap (in shavings) in one-half of the Water previously mixed with the Water of Ammonia, and the Ammonium Chloride in the other half. Mix the solutions well, and add the Camphor dissolved in the Oil; then agitate briskly until the liquids are united and form a perfect emulsion.

Pills of Camphor and Opium.

Camphor,	48 gr.
Powdered Opium,	12 gr.
Alcohol,	12 min.
Confection of Rose, sufficient.	

Make a mass and divide into 24 pills. Dose, 1 to 2 pills.

Compound Powder of Camphor.

(Gallop's Powder.)

Camphor,	
Powdered Acacia,	
Sugar,	of each, 1 oz.

Mix.

Mixture of Thymol.

(L. Lewin.)

Thymol,	1½ gr.
Orange Flower Water,	1½ fl. oz.
Distilled Water,	8½ fl. oz.

Mix. Dose, a tablespoonful several times a day.

Thymol Inhalation.

(Warren.)

Thymol,	8 gr.
Sodium Borate,	800 gr.
Glycerin,	10 fl. dr.
Camphor Water,	2½ fl. oz.
Tar Water,	7 fl. oz.

Mix. To be used as an inhalation by means of an atomizer.

Antiseptic Solution.

(Volkman's.)

Thymol,	30 gr.
Alcohol,	5 fl. dr.
Glycerin,	10 fl. dr.
Water,	6 fl. oz.

Mix.

Cough Mixture.

(Prof. Pancoast.)

Wild Cherry Bark,	240 gr.
Senega,	240 gr.
Ipecac,	120 gr.
Extract of Conium,	15 gr.
Compound Tincture of Cardamom,	1 fl. oz.
Compound Spirit of Juniper,	1 fl. oz.
Water, sufficient to make	10 fl. oz.

Percolate the solid ingredients with sufficient Water to make 8 fl. oz., then add the other ingredients. Two teaspoonfuls in water constitute the usual dose to relieve cough.

Antispasmodic Powders.

(Dr. Otto's.)

Ground Black Mustard,	240 gr.
Powdered Salvia,	240 gr.
Powdered Ginger,	240 gr.

Mix. Dose, in epilepsy, three teaspoonfuls for three mornings in succession; discontinue three mornings, and then give as before. To be mixed in water or molasses.

Garlic Ointment.

Fresh Garlic,	6 bulbs.
Lard,	2 oz. (troy).

Digest at a moderate heat for an hour, and strain.

VOLATILE OILS WITH RESIN PRODUCTS.

Confection of Black Pepper.

(Ward's Paste.)

Black Pepper,	2 oz. (troy).
Powdered Inula,	2 oz. (troy).
Powdered Fennel,	6 oz. (troy).
Honey,	4 fl. oz.
Sugar,	4 oz. (troy).

Rub the dry ingredients together into a very fine powder, and keep them in a covered vessel; but, whenever the confection is to be used, add the powder gradually to the Honey, and beat them until thoroughly incorporated. Dose, 60 to 120 grains three times a day.

Emulsion of Cubeb.

Oleoresin of Cubeb,	120 drops.
Yolk of Egg,	1.
Sugar,	120 gr.
Peppermint Water,	8 fl. oz.

Triturate the Oleoresin with the Sugar and Yolk of Egg, and then dilute with Peppermint Water. Dose, a teaspoonful four times a day.

Ethereal Tincture of Cubeb.

Cubeb,	2 oz. (troy).
Spirit of Nitrous Ether,	16 fl. oz.

Macerate for eight days, and filter.

Syrup of Cubeb.

(Mitchell's.)

Fluid Extract of Cubeb,	2 fl. oz.
Magnesium Carbonate,	240 gr.
Sugar,	12 oz. (troy).
Oil of Bitter Almond,	1 min.
Orange Flower Water,	2 fl. oz.
Water, a sufficient quantity to make	16 fl. oz.

Rub the Fluid Extract with the Magnesium Carbonate, and then add 2 fl. oz. of the Sugar in small portions; when thoroughly mixed, add gradually first the Orange Flower Water and then 7 fl. oz. of Water, constantly triturating the mixture until the Sugar is dissolved; filter, and add sufficient Water to measure 11 fl. oz., in which dissolve the remainder of the Sugar, without heat; add the Oil dissolved in a little Alcohol, and sufficient Water to make 16 fl. oz.

Compound Pills of Copaiba.

Copaiba,	80 gr.
Powdered Cubeb,	50 gr.
Wax,	15 gr.

Melt the Wax by a gentle heat, then

add the Copaiba, and immediately afterwards sift in the Cubebs, stirring thoroughly; while it is yet warm, roll out into 25 pills.

Cubeb Mixture.

(Dr. J. Wm. White's.)

Oleoresin of Cubeb,	4 fl. dr.
Potassium Bromide,	1 oz. (troy).
Syrup of Acacia,	2 fl. oz.
Oil of Sassafras,	10 min.
Water, sufficient to make	6 fl. oz.

Mix.

La Fayette Mixture.

Copaiba,	1 fl. oz.
Spirit of Nitrous Ether,	1 fl. oz.
Fluid Extract of Glycyrrhiza,	4 fl. dr.
Solution of Potassa,	2 fl. dr.
Oil of Gaultheria,	16 min.
Syrup of Acacia,	6 fl. oz.

Mix.

Copaiba Mixture.

(Chapman's.)

Copaiba,	4 fl. oz.
Powdered Acacia,	120 gr.
Sugar,	60 gr.
Spirit of Nitrous Ether,	4 fl. oz.
Compound Tincture of Lavender,	2 fl. oz.
Tincture of Opium,	1 fl. dr.
Distilled Water,	4 fl. oz.

Mix. Dose, a tablespoonful three times a day.

Alkaline Copaiba Mixture.

Copaiba,	4 fl. dr.
Acacia,	240 gr.
Sugar,	240 gr.
Solution of Potassa,	4 fl. dr.
Spearmint Water, a sufficient quantity to make	8 fl. oz.

Mix the Copaiba and Solution of Potassa; add the Water, and triturate with the Acacia and Sugar.

Diphtheria Mixture.

(Dr. Bergerou's.)

Copaiba,	20 min.
Syrup of Orange,	4 fl. dr.
Peppermint Water,	8 fl. dr.
Alcohol,	6 fl. oz.

Mix. Dose, a tablespoonful every two hours, in non-infectious diphtheria, to aid the disappearance of the false membrane.

Solution of Santal, Copaiba, and Cubeb.

(Nesbit's specific.)

Oil of Santal,	5 fl. oz.
Oil of Copaiba,	4 fl. dr.
Oil of Cubeb,	4 fl. dr.
Oil of Pimenta,	1 fl. dr.
Oil of Cassia,	1 fl. dr.
Alcohol, sufficient to make	16 fl. oz.

Mix. Dose, a teaspoonful twice a day in water.

Compound Fluid Extract of Buchu.

Oil of Juniper,	12 min.
Spirit of Nitrous Ether,	8 fl. oz.
Fluid Extract of Cubeb,	3 fl. oz.
Fluid Extract of Buchu,	10 fl. oz.

Dissolve the Oil of Juniper in the Spirit of Nitrous Ether, and mix with the Fluid Extracts. Do not filter; but shake well before dispensing.

Elixir of Hops.

Fluid Extract of Hops,	10 fl. dr.
Elixir of Orange, a sufficient quantity to make	8 fl. oz.

Mix.

Tinctura Lupulinæ. *U. S.* 1870. TINCTURE OF LUPULIN.

Lupulin,	4 oz. (troy).
Alcohol, a sufficient quantity.	

Pack the Lupulin in a narrow cylindrical percolator, and gradually pour Alcohol upon it until 32 fl. oz. of tincture are obtained.

Ethereal Tincture of Cannabis Indica.

Extract of Cannabis (Squire's),	240 gr.
Spirit of Nitrous Ether,	8 fl. oz.

Triturate together in a mortar till the extract is dissolved. Dose, 5 to 15 drops.

Ethereal Tincture of Guaiac.

Guaiac,	1½ oz. (troy).
Spirit of Nitrous Ether,	8 fl. oz.

Make by maceration. Dose, a teaspoonful.

Anthelmintic Syrup.

Fluid Extract of Senna,	1 fl. dr.
Oil of Chenopodium,	1 fl. dr.
Syrup of Rhubarb,	2 fl. oz.

Mix. Dose, a teaspoonful three times a day.

Arnica Liniment.

Arnica Flowers,	2 oz. av.
Glycerin,	8 fl. oz.

Digest at a moderate temperature on a water-bath, express, and strain.

Syrup of Anthemis.

Anthemis,	240 gr.
Sugar,	10 oz. (av.).
Water,	6 fl. oz.

Make an infusion of the flowers with the Water, and add the Sugar, dissolving without heat.

Emulsion of Aspidium.

Fluid Extract of Aspidium,	1 fl. dr.
Tincture of Quillaia,	30 min.
Distilled Water, sufficient to make	1 fl. oz.

Mix.

Nerve Powder.

(Thomsonian name.)

Powdered Cypripedium.

Liniment of Stillingia.

Oil of Stillingia,	1 fl. oz.
Oil of Cajuput,	4 fl. dr.
Oil of Lobelia,	2 fl. dr.
Alcohol,	2 fl. oz.

Mix. Used as a local application in croup, and as a cough medicine, in doses of 1 drop on a lump of sugar.

Syrup of Lactucarium.

(Aubergier's, modified.)

Fluid Extract of Lactucarium (U. S.),	4 fl. dr.
Syrup of Orange Flowers,	4 fl. oz.
Syrup,	10 fl. oz.

Mix.

Cough Lozenges.

(Keating's.)

Lactucarium,	120 gr.
Ipecac,	60 gr.
Squill,	45 gr.
Extract of Glycyrrhiza,	120 gr.
Sugar,	2 oz. (troy).

Mix. Make into a mass with Tragacanth and Mucilage, and divide into 20-grain lozenges.

RESINS, OLEORESINS, GUM-RESINS, AND BALSAMS.

Thomson's Salve.

(Thomsonian name.)

Yellow Wax,	2 oz. (troy).
Fresh Butter,	2 oz. (troy).
Turpentine,	4 oz. (troy).
Balsam of Fir,	2 oz. (troy).

Mix.

Haarlem Oil.

Sulphurated Oil,	12 fl. oz.
Petroleum (Barbadoes),	4 fl. oz.
Oil of Amber (crude),	6 fl. oz.
Oil of Turpentine,	32 fl. oz.
Linseed Oil,	16 fl. oz.

Mix. The Sulphurated Oil is made by boiling 1 part of Sulphur with 8 parts of Olive Oil until they are united.

St. John Long's Liniment.

Yolk of Egg,	1.
Oil of Turpentine,	8 fl. oz.
Acetic Acid,	5 fl. dr.
Rose Water,	2½ fl. oz.
Oil of Lemon,	30 min.

Mix.

Emulsion of Turpentine.

Oil of Turpentine,	20 min.
Tincture of Quillaia,	20 min.
Distilled Water,	1 fl. oz.

Mix.

Emulsion of Turpentine.

(J. W. Forbes.)

Oil of Turpentine,	1 fl. oz.
Powdered Acacia,	20 gr.
Water,	4 fl. dr.

Place the Oil in a dry bottle, add the Powdered Acacia, shake well, and mix thoroughly with the Oil; lastly, add the Water, and shake the whole thoroughly.

Stokes's Liniment.

Yolk of Egg,	1.
Oil of Lemon,	60 min.
Acetic Acid,	4 fl. dr.
Oil of Turpentine,	3 fl. oz.
Rose Water,	3 fl. oz.

Mix.

Fever Liniment.

(Saint Barthelemy's.)

Oil of Turpentine,	3½ fl. dr.
Tincture of Opium,	80 min.
Camphor,	50 gr.
Olive Oil,	2 fl. oz.

Mix. Apply for six minutes every six hours to the whole spine.

Mistura Pini Sylvestris.

(Dr. Piffard's.)

Tar,	100 gr.
Oil of Lavender,	100 gr.
Oil of Scotch Fir (*Pinus sylvestris*),	300 gr.

Mix and filter.

Ceratum Resinæ Compositum. *U. S.* 1870. Compound Resin Cerate. (Deshler's Salve.)

Resin,		
Suet,		
Yellow Wax,	each,	6 oz. (troy).
Turpentine,		3 oz. (troy).
Oil of Flaxseed,		3½ oz. (troy).

Melt them together, strain the mixture through muslin, and stir it constantly until cool.

Breast Plaster.

(Dewees'.)

Ammoniac Plaster,	120 gr.
Lead Plaster,	1½ oz. (troy).
Logan's Plaster,	360 gr.
Spermaceti,	60 gr.
Camphor,	60 gr.

Melt the Plasters, then add the Spermaceti and Camphor, and remove from the fire.

Sedative Pills.

(Gunther's.)

Powdered Asafetida,	57 gr.
Extract of Valerian,	57 gr.
Extract of Belladonna,	3 gr.
Oxide of Zinc,	1 gr.
Castor,	2 gr.

Mix, and make into 24 pills. Dose, 1 to 2 pills twice daily in chorea.

Syrup of Asafetida.

Asafetida,	240 gr.
Sugar,	16 oz. (av.).
Boiling Water,	8 fl. oz.

Rub the Asafetida with part of the Boiling Water until a uniform paste is made, then gradually add the rest of the Water, strain, and add the Sugar, using a gentle heat to dissolve it. Dose, a tablespoonful.

Number Six.

(Rheumatic Drops.)

(Thomsonian name.)

Capsicum,	1 oz. (av.).
Myrrh,	16 oz. (av.).
Alcohol,	8 pints.

Made by maceration.

Compound Infusion of Myrrh.

Myrrh,	23 gr.
Aloes,	23 gr.
Saffron,	23 gr.
Potassium Carbonate,	15 gr.
Powdered Extract of Glycyrrhiza,	120 gr.
Water,	6 fl. oz.
Compound Tincture of Cardamom,	2 fl. oz.

Boil slowly to 4 fl. oz., strain, and add the Compound Tincture of Cardamom.

Liniment of Hypericum.

(Red Oil.)

Flowers of Hypericum (fresh), 8 oz. (troy).
Olive Oil, a sufficient quantity to cover the flowers.

Macerate in the sun for fourteen days, express, and strain.

Tincture of Guaiac.

(Dewees'.)

Guaiac (powdered),	2 oz. (troy).
Potassium Carbonate,	45 gr.
Pimenta (powdered),	240 gr.
Diluted Alcohol,	16 fl. oz.

Digest for two weeks. Dose, 1 to 2 teaspoonfuls.

Emulsion of Guaiac.

Guaiac (powdered),	12 gr.
Tincture of Quillaia,	1 fl. dr.
Distilled Water,	1 fl. oz.

Dissolve the Guaiac in the Tincture, filter, and then mix with the Water.

Syrup of Guaiac.

Guaiac (powdered),	640 gr.
Potassa,	58 gr.
Sugar,	16 oz. (av.).
Water, sufficient to make	8 fl. oz.

Dissolve the Potassa in 8 fl. oz. of Water, add the Guaiac, macerate seven days, filter, add the Sugar, and strain.

Pills Number Three (Anti-Canker).

(Thomsonian name.)

Capsicum,	1 oz. (av.).
Extract of Bayberry,	1 oz. (av.).

Make into pills.

Number Five.

(Restorative Cordial.)

(Thomsonian name.)

White Aspen,	
Black Aspen,	
Poplar Bark,	of each, 8 oz. (av.).
Bayberry Root Bark,	16 oz. (av.).

Boil a few minutes in 2 gallons of Water, strain, add 7 pounds of Sugar, skim, and then 3 quarts of Brandy.

Syrup of Bayberry.

(Thomsonian name.)

Bayberry,	12 oz. (troy).
Sugar,	12 oz. (troy).
Diluted Alcohol,	64 fl. oz.

Digest the Bayberry in the Diluted Alcohol for two days, strain, and evaporate to 16 fl. oz.; add the Sugar.

Composition Powder.

(Thomsonian name.)

Bayberry Root Bark,	12 oz.
Ginger,	6 oz.
Capsicum,	
Cloves,	of each, 1 oz.

All in fine powder. Mix.

Balsamic Mixture.

(Hoffman's.)

Oil of Lavender,	
Oil of Cloves,	
Oil of Cassia,	
Oil of Thyme,	
Oil of Lemon,	
Oil of Mace,	
Oil of Orange Flowers,	of each, 30 min.
Balsam of Peru,	90 min.
Alcohol, sufficient to make	16 fl. oz.

Mix.

(Also called Hoffman's Balsam of Life.)

Tolu Cough Mixture.

Syrup of Squill,	4 fl. dr.
Tincture of Tolu,	1 fl. dr.
Syrup,	8 fl. oz.

Mix. Dose, a teaspoonful.

Turlington's Balsam.

Benzoin,	3 oz. (troy).
Storax,	1 oz. (troy).
Aloes,	120 gr.
Myrrh,	120 gr.
Angelica,	60 gr.
Balsam of Peru,	4 fl. dr.
Balsam of Tolu,	1 oz.
Extract of Glycyrrhiza,	1 oz. (troy).
Alcohol,	32 fl. oz.

Digest for ten days, and filter.

Borobenzoate of Sodium.

(T. S. Wiegand.)

Sodium Borate,	3 oz. (troy).
Sodium Benzoate,	4 oz. (troy).

Water, sufficient to dissolve.

Make a solution of the Salts in the Water, filter, and evaporate, with constant stirring, to dryness.

FATS, FIXED OILS, SOAPS, ETC.

British Oil.

Petroleum, Barbadoes,	1 fl. oz.
Petroleum, American,	1 fl. oz.
Oil of Turpentine,	2 fl. oz.
Oil of Linseed,	24 fl. oz.
Oil of Amber,	8 fl. oz.
Oil of Juniper,	2 fl. dr.

Mix them well together.

Emulsion of Pumpkin-Seed.

Pumpkin-Seed (fresh),	2 oz. (av.).
Powdered Acacia,	60 gr.
Sugar,	240 gr.
Water,	4 fl. oz.

Blanch the seed, after soaking them in hot water, beat them into a mass with the Sugar, then add the Acacia, and gradually the Water.

Emulsion of Castor Oil.

Castor Oil,	4 fl. dr.
Tincture of Quillaia,	30 min.
Distilled Water, sufficient to make	1 fl. oz.

Mix.

Ointment of Croton Oil.

Croton Oil,	30 min.
Lard,	1 oz. (troy).

Mix gradually.

Pills of Croton Oil.

Croton Oil,	6 min.
Crumb of Bread,	24 gr.

Make into 24 pills.

Croton Oil Pencils.

(Limousin's.)

Croton Oil,	2 fl. dr.
White Wax,	60 gr.
Oil of Theobroma,	60 gr.

Melt the Wax and Oil of Theobroma together, by means of a water-bath, in a flask, adding the Croton Oil, and keep the flask corked until the mixture begins to congeal; then pour into suitable cylindrical moulds, one-fourth to one-third of an inch in diameter. The pencils are covered with tin foil and kept in closed vessels.

Stronger Laxative Mixture.

(Bossu's.)

Resin of Scammony, Resin of Jalap, of each,	½ gr.
Sugar,	15 gr.
Croton Oil,	2 min.
Mucilage,	30 min.
Orange Flower Water,	90 min.
Compound Syrup of Senna,	1 fl. oz.
Peppermint Water,	3 fl. oz.

Dose, a tablespoonful.

Glycerin Ointment.

Spermaceti,	240 gr.
White Wax,	60 gr.
Glycerin,	1 fl. oz.
Expressed Oil of Almond,	3 fl. oz.

Melt the Wax and Spermaceti with the Oil at a moderate heat; put these in a wedgwood mortar, add the Glycerin, and triturate until cold.

Glycerin Lotion.

Glycerin,	8 oz. (troy).
Cydonium,	60 gr.
Water,	8 fl. oz.
Oil of Bitter Almond,	10 min.

Macerate the Cydonium with the Water, strain, and add the Glycerin and Oil of Bitter Almond.

Ceratum Saponis. *U. S.* 1870.

SOAP CERATE.

Soap Plaster,	2 oz. (troy).
Yellow Wax,	2½ oz. (troy).
Olive Oil,	4 oz. (troy).

Melt together the Plaster and Wax, add the Oil, and, after continuing the heat a few minutes, stir the mixture until cool.

Pilula Saponis Composita. *U. S.* 1870.

COMPOUND PILL OF SOAP.

Opium, in fine powder,	60 gr.
Soap, in fine powder,	240 gr.

Beat them together with water so as to form a pilular mass.

Opodeldoc.

(Solid.)

Camphor,	1 oz. (troy).
Soap,	3 oz. (troy).
Oil of Origanum,	1 fl. dr.
Oil of Rosemary,	1 fl. dr.
Alcohol,	16 fl. oz.

Digest the Soap, by means of a sand-bath, with the Alcohol till it is dissolved, then add the Camphor and Oils, and, when they are dissolved, pour the liquid into wide-mouth two-ounce bottles.

Bathing Spirits.

(Jackson's.)

Soap,	8 oz. (troy).
Camphor,	8 oz. (troy).
Oil of Rosemary,	3 fl. dr.
Oil of Thyme,	3 fl. dr.
Alcohol,	64 fl. oz.

Mix.

Compound Tincture of Green Soap.

(Tilbury Fox.)

Green Soap,	1 oz. (troy).
Oil of Lavender,	90 min.
Oil of Cade, Alcohol, of each,	1 fl. oz.

Mix.

Green Soap Lotion.

(Hebra's.)

Green Soap,	240 gr.
Oil of Lavender,	15 min.
Boiling Water,	8 fl. oz.

Mix.

Tincture of Green Soap with Tar.

(Hebra's.)

Green Soap,	1 oz. (troy).
Tar,	
Alcohol,	of each, 1 fl. oz.

DRUGS CONTAINING BITTER PRINCIPLES, ETC.

Tonic Tea.

(Gerhard's.)

Gentian,	1 oz. (troy).
Rhubarb,	120 gr.
Ginger,	240 gr.
Sodium Bicarbonate,	120 gr.
Boiling Water,	32 fl. oz.

Bruise the Gentian, Rhubarb, and Ginger, mix them, and add the Sodium Bicarbonate; then infuse in 32 fl. oz. of Boiling Water. Dose, a wineglassful three times a day.

Elixir of Gentian with Chloride of Iron.

Compound Fluid Extract of Gentian,	4 fl. dr.
Tincture of Chloride of Iron (tasteless),	2½ fl. dr.
Elixir of Orange, a sufficient quantity to make	8 fl. oz.

Mix.

Compound Elixir of Taraxacum.

Taraxacum,	3 oz. (troy).
Wild Cherry,	2 oz. (troy).
Gentian,	240 gr.
Orange Peel,	1 oz. (troy).
Glycyrrhiza,	1 oz. (troy).
Cinnamon,	240 gr.
Cardamom,	60 gr.
Anise,	60 gr.
Water,	
Alcohol, each, a sufficient quantity.	
Syrup,	20 fl. oz.

Reduce the solids to a powder, and percolate with a menstruum of 1 part Alcohol and 3 parts Water until 3½ pints of tincture are obtained; add the Syrup; allow it to stand four weeks, if possible, and filter.

Tincture of Burdock-Seed.

Ground Burdock-Seed,	4 oz. (troy).
Water,	4 fl. oz.
Alcohol,	12 fl. oz.

Mix the liquids, and percolate in the usual way until 16 fl. oz. of tincture are obtained. Dose, a teaspoonful three or four times a day.

Elixir of Gentian.

Compound Fluid Extract of Gentian,	4 fl. dr.
Elixir of Orange, a sufficient quantity to make	8 fl. oz.

Mix.

Boker's Bitters.

Quassia,	60 gr.
Calamus,	60 gr.
Catechu,	60 gr.
Cardamom,	40 gr.
Orange Peel,	90 gr.
Whisky,	5½ fl. oz.
Water,	24 fl. oz.

Macerate, and filter.

Cutter's Pills.

(For habitual costiveness.)

Powdered Ipecac,	10 gr.
Mild Chloride of Mercury,	3 gr.
Extract of Taraxacum,	40 gr.

Make into a mass and divide into 30 pills. Dose, one three times a day.

Pilulæ Scillæ Compositæ. *U. S.* 1870.

Compound Pills of Squill.

Squill, in fine powder,	12 gr.
Ginger, in fine powder,	
Ammoniac, in fine powder, of each,	24 gr.
Soap, in fine powder,	36 gr.
Syrup, a sufficient quantity.	

Mix the powders, then beat them with Syrup so as to form a pilular mass. To be divided into 24 pills.

Tincture of Quillaia.

(For emulsions.)

Quillaia,	4 oz. (av.).
Alcohol,	16 fl. oz.

Digest for three days, and then strain.

Tinctura Hellebori. *U. S.* 1870. Tincture of Black Hellebore.

Black Hellebore, in moderately fine powder,	4 oz. (troy).
Diluted Alcohol, a sufficient quantity.	

Moisten the powder with 1 fl. oz. of Diluted Alcohol, pack it in a cylindrical percolator, and gradually pour Diluted Alcohol upon it until 2 pints of tincture are obtained.

Laxative Syrup.

(Amussart's.)

Rasped Guaiac Wood,	
Chicory Root,	
Lappa,	
Water-Dock Root,	
Fumitory Tops,	
Tops of Viola Tricolor,	of each, 154 gr.
Senna,	770 gr.
Sugar,	
Honey,	of each, 10½ oz. (av.).
Boiling Water, sufficient.	

Bruise the materials, and infuse for

twelve hours with 18 fl. oz. of Boiling Water; strain, and make a second infusion with 10 fl. oz. of Water; strain under pressure, filter through paper (evaporate to one-fourth), then add the Honey and Sugar and shake until dissolved; strain. Dose, 1 to 2 tablespoonfuls a day.

Hooper's Pills.

Powdered Ginger,	60 gr.
Powdered Canella,	60 gr.
Extract of Black Hellebore,	120 gr.
Myrrh,	120 gr.
Soap,	120 gr.
Dried Sulphate of Iron,	130 gr.
Aloes,	1 oz. (troy).

Beat them well together into a mass with syrup or water, and divide into pills each containing 2½ gr.

Syrup of Gillenia.

Gillenia,	1 oz. (troy).
Sugar,	15 oz. (troy).
Diluted Alcohol,	8 fl. oz.
Water,	5 fl. oz.

Reduce the Gillenia to a coarse powder, percolate with Diluted Alcohol until 8 fl. oz. are obtained, evaporate to 3 fl. oz., filter, and add sufficient Water to make the liquid measure 8 fl. oz.; then add the Sugar, and dissolve by a gentle heat.

Worm Tea.

Spigelia,	240 gr.
Manna,	240 gr.
Senna,	120 gr.
Fennel,	60 gr.

Contuse the Spigelia and mix it with the other ingredients; infuse in 16 fl. oz. of Boiling Water. Give a child, two years old or upwards, half a teacupful, warm, morning, noon, and night, before eating.

Trochisci Santonini. *U. S.* 1870.

TROCHES OF SANTONIN.

Santonin, in fine powder,	240 gr.
Sugar, in fine powder,	18 oz. (troy).
Tragacanth, in fine powder,	240 gr.
Orange Flower Water,	a sufficient quantity.

Rub the powders together until they are thoroughly mixed; then, with Orange Flower Water, form a mass, to be divided into 480 troches.

CATHARTIC DRUGS.

Zimmerman's Decoction.

Rhubarb,	30 gr.
Potassium Bitartrate,	240 gr.
Barley,	240 gr.
Water,	16 fl. oz.

Boil for fifteen or twenty minutes, strain, and add enough simple syrup or sugar to sweeten the decoction.

Tamarind Electuary.

(Fuller's.)

Sugar,	300 gr.
Manna,	1½ oz. (troy).
Tamarind,	210 gr.
Potassium Bitartrate,	30 gr.
Powdered Senna,	120 gr.
Boiling Water,	3 fl. oz.

Dissolve the Sugar and Manna in the Boiling Water, and filter, then add the other ingredients.

Aperient Pills.

(Dr. Mitchell's.)

Powdered Aloes,	24 gr.
Powdered Rhubarb,	48 gr.
Mild Chloride of Mercury,	4 gr.
Antimony and Potassium Tartrate,	2 gr.

Make into a mass and divide into 24 pills.

Tinctura Rhei et Sennæ. *U. S.* 1870.

TINCTURE OF RHUBARB AND SENNA.

Rhubarb,	1 oz. (troy).
Senna,	120 gr.
Coriander,	
Fennel, of each,	60 gr.
Glycyrrhiza,	30 gr.
Raisins, deprived of their seeds,	6 oz. (troy.)
Diluted Alcohol,	48 fl. oz.

Macerate for seven days, express, and filter through paper.

Compound Powder of Senna.

Powdered Senna,	2 oz. (troy).
Potassium Bitartrate,	2 oz. (troy).
Powdered Scammony,	240 gr.
Powdered Ginger,	120 gr.

Mix. Dose, 20 to 30 grains.

Chelsea Pensioner.

Rhubarb,	120 gr.
Powdered Guaiac,	60 gr.
Potassium Bitartrate,	1 oz. (troy).
Sulphur,	2 oz. (troy).
Powdered Nutmeg,	60 gr.
Honey,	10 fl. oz.

Make into a confection.

Laxative, or Podophyllum Pills.

(Squibb's.)

Resin of Podophyllum,	6 gr.
Alcoholic Extract of Belladonna, or Alcoholic Extract of Hyoscyamus,	3 gr.
Powdered Capsicum,	24 gr.
Powdered Sugar of Milk,	24 gr.
Powdered Acacia,	6 gr.
Glycerin,	6 min.
Syrup,	sufficient.

Mix, and make into 24 pills. Dry these by exposure until just hard enough to retain their form, then put into bottles.

Liver Pills.

(Dr. Chapman.)

Powdered Rhubarb,	60 gr.
Powdered Ipecac,	10 gr.
Powdered Acacia, sufficient.	
Oil of Caraway,	10 min.

Mix, and make into 20 pills.

Purgative Tincture.

(Dobell's.)

Resin of Podophyllum,	8 gr.
Tincture of Ginger,	5 fl. dr.
Alcohol,	8 fl. dr.

Mix. Dose, a teaspoonful at night, when lying down.

Laxative Confection.

Potassium Bitartrate,	240 gr.
Powdered Jalap,	240 gr.
Confection of Senna,	1 oz. (troy).

Make into a mass, using Syrup of Ginger if too hard. Dose, a piece the size of a marble three times daily.

Tinctura Jalapæ. *U. S.* 1870. TINCTURE OF JALAP.

Jalap, in fine powder,	6 oz. (troy).
Alcohol,	
Water, each, a sufficient quantity.	

Mix two measures of Alcohol with one of Water; then moisten the powder with 2 fl. oz. of the mixture; pack it moderately in a cylindrical percolator, and gradually pour the mixture upon it until 32 fl. oz. of tincture are obtained.

Compound Tincture of Jalap.

(TINCTURA PURGANS.)

Jalap,	1 oz. (troy).
Turpeth Root,	60 gr.
Scammony,	120 gr.
Alcohol (60 per cent.),	12 fl. oz.

Macerate for ten days, express, and filter. Dose, 1 to 4 tablespoonfuls. Known in France as Eau-de-Vie Allemande, also Lavolley's Purgative Elixir. Sweetened with Sugar it is the Elixir Antiglaireux de Guillie.

Mettauer's Aperient.

Aloes (in coarse powder),	300 gr.
Sodium Bicarbonate,	600 gr.
Fluid Extract of Valerian,	1 fl. oz.
Compound Tincture of Lavender,	1 fl. oz.
Water,	16 fl. oz.

Mix. Macerate for seven days, and filter. Dose, a tablespoonful.

Elixir Clauderi.

Potassium Carbonate,	240 gr.
Aloes,	60 gr.
Guaiac,	60 gr.
Myrrh,	60 gr.
Saffron,	60 gr.
Rhubarb,	60 gr.
Water,	9 fl. oz.

Macerate a few days, and decant. Dose, a tablespoonful.

Compound Syrup of Juglans.

(SYRUPUS ANTIRHACHITICUS.)

(Vanier's.)

Extract of Walnut Leaves,	152 gr.
Extract of Cinchona,	75 gr.
Potassium Iodide,	40 gr.
Anise Oil Sugar,	115 gr.
Alcohol,	2½ fl. dr.
White Wine,	4 fl. dr.
Syrup,	12 fl. oz.

Dose, for small children, a teaspoonful four to five times a day; for older children, half a tablespoonful. Vanier's syrup is said to contain, in addition to the above, 5 per cent. of Cod Liver Oil.

Triplex Pills.

(Dr. J. W. Francis's.)

Aloes,	1 oz. (troy).
Scammonium,	1 oz. (troy).
Mass of Mercury,	1 oz. (troy).
Oil of Caraway,	90 min.
Croton Oil,	20 min.
Tincture of Aloes and Myrrh, a sufficient quantity.	

Make into 400 pills.

Triplex Pills.

Purified Aloes,	800 gr.
Mass of Mercury,	400 gr.
Resin of Podophyllum,	100 gr.
Syrup, sufficient to make a mass.	

Divide into 400 pills.

Anderson's Scots Pills.

Aloes,	1 oz. (troy).
Soap,	80 gr.
Colocynth,	20 gr.
Gamboge,	20 gr.
Oil of Anise,	10 min.

Let the Aloes, Colocynth, and Gamboge be reduced to a very fine powder; then beat them and Soap with Water into a mass of a proper consistence to divide into pills each containing 3 gr.

Pulvis Aloës et Canellæ. *U. S.* 1870. POWDER OF ALOES AND CANELLA (HIERA PICRA).

Socotrine Aloes, in fine powder,	6 oz. (troy).
Canella, in fine powder,	1½ oz. (troy).

Rub them together until they are thoroughly mixed.

Dinner Pills.

(Dr. Chapman's.)

Powdered Aloes,	36 gr.
Powdered Mastic,	36 gr.
Powdered Ipecac,	24 gr.
Oil of Caraway,	4 min.

Make into a mass and divide into 24 pills.

Knight's Pills.

Powdered Aloes,	54 gr.
Powdered Scammony,	27 gr.
Powdered Gamboge,	9 gr.

Mix, and make into 20 pills.

Pills of Aloin and Podophyllin.

Aloin,	24 gr.
Podophyllin,	12 gr.
Oleoresin of Ginger,	4 min.

Triturate the solid ingredients into a uniform powder, add the Oleoresin, make a mass, and divide into 24 pills. Dose, 1 to 3 pills.

Marshall's Pills.

Compound Extract of Colocynth,	
Mass of Mercury,	
Powdered Aloes,	
Powdered Soap,	
Powdered Rhubarb, of each,	60 gr.

Make into 60 pills.

Barker's Pills.

Compound Extract of Colocynth,	20 gr.
Extract of Hyoscyamus,	15 gr.
Aloes,	10 gr.
Extract of Nux Vomica,	5 gr.
Podophyllum,	1 gr.
Powdered Ipecac,	1 gr.

Mix, and make into 12 pills.

Boisragon Pills.

(Dr. Hewson's formula.)

Mild Chloride of Mercury,	12 gr.
Powdered Scammony,	12 gr.
Compound Extract of Colocynth,	40 gr.
Oil of Caraway,	4 min.
Aloes,	8 gr.

Mix, and make into 14 pills.

Cobb's Pills.

Extract of Hyoscyamus,	30 gr.
Extract of Conium,	30 gr.
Extract of Colocynth,	40 gr.
Extract of Nux Vomica,	4 gr.

Mix, and divide into 30 pills.

Laxative Pills.

(Cole's.)

Compound Extract of Colocynth,	60 gr.
Mild Chloride of Mercury,	20 gr.
Resin of Podophyllum,	2 gr.

Mix, and make into 20 pills.

Aromatic Syrup of Galls.

Nutgall,	240 gr.
Cinnamon,	120 gr.
Nutmeg,	120 gr.
Glycerin,	6 fl. dr.
Syrup,	6 fl. oz.
Brandy, sufficient.	

Mix the powders, and, having moistened the mixture with a sufficient quantity of Brandy, pack it firmly in a small conical glass percolator, and gradually pour Brandy upon it until it commences to drop; then insert a cork tightly in the lower orifice of the percolator, and let it stand twenty-four hours; then withdraw the cork, and continue the percolation with Brandy until 6 fl. oz. of tincture are obtained. Mix this with the Glycerin, and evaporate by a water-bath, at a temperature not exceeding 125° F., to 3 fl. oz., filter, and thoroughly mix with the Syrup.

Astringent Tincture.

(Aromatic Tincture of Galls.)

(Gilbert's.)

Nutgall,	16 oz. (av).
Oil of Citron,	30 min.
Oil of Bergamot,	30 min.
Oil of Lemon,	30 min.
Oil of Thyme,	8 min.
Oil of Lavender,	8 min.
Oil of Rosemary,	8 min.
Tincture of Benzoin,	1 fl. dr.
Alcohol (90 per cent.), sufficient.	

Exhaust the Gall by percolation with Alcohol, distil off the Alcohol, and evaporate to 8 fl. oz.; redissolve this extract in 8 fl. oz. of Alcohol, add the Oils, and filter.

Pavesi's Hæmostatic.

Sulpho-Carbolic Acid,	3 fl. dr.
Benzoic Acid,	37 gr.
Tannic Acid,	37 gr.
Alcohol,	3 fl. dr.
Glycerin,	3 fl. dr.
Rose Water,	3 fl. oz.

The Sulpho-Carbolic Acid is prepared by mixing 1 part Sulphuric Acid and ½ part Carbolic Acid and heating for a few minutes on a water-bath; the Benzoic Acid is dissolved in the Alcohol and Glycerin, the Tannic Acid in the Water, and both mixed.

Hæmostatic Collodion.

(Pavesi's.)

Tannic Acid,	80 gr.
Benzoic Acid,	45 gr.
Carbolic Acid,	158 min.
Collodion,	3½ fl. oz.

Mix and dissolve.

Pile Ointment.

Morphine Acetate,	5 gr.
Tannic Acid,	30 gr.
Solution of Subacetate of Lead,	1 fl. dr.
Ointment,	420 gr.

Incorporate the Solution with the Ointment, then add the other ingredients.

Glyceritum Acidi Tannici. *U. S.* 1870.

Glycerite of Tannic Acid.

Tannic Acid,	1 oz. (troy).
Glycerin,	4 fl. oz.

Rub them together in a mortar, then

transfer the mixture to a porcelain dish, and apply a gentle heat until complete solution is effected.

Tannin Nasal Bougies.

Tannic Acid,	31 gr.
Tragacanth,	100 gr.
Althæa,	31 gr.
Glycerin,	100 min.
Distilled Water,	50 min.

Make 4 cuneiform rods three inches long, upon a pill-tile, using powdered Althæa to dust the tile. To be moistened before being introduced into the nose.

Glyceritum Acidi Gallici. *U. S.* 1870.

GLYCERITE OF GALLIC ACID.

Gallic Acid,	2 oz. (troy).
Glycerin,	8 fl. oz.

Rub them together in a mortar, then transfer to a glass or porcelain capsule, and heat gently until the Acid is dissolved.

Infusum Catechu Compositum. *U. S.* 1870. COMPOUND INFUSION CATECHU.

Catechu, in fine powder,	240 gr.
Cinnamon, in moderately fine powder,	60 gr.
Boiling Water,	16 fl. oz.

Macerate in a covered vessel, and strain.

Compound Tincture of Kino.

Powdered Opium,	60 gr.
Powdered Kino,	60 gr.
Camphor,	90 gr.
Cloves,	90 gr.
Diluted Alcohol,	16 fl. oz.

Make a tincture by percolation.

Diarrhœa Mixture.

(Dr. Wm. Gould.)

Compound Tincture of Rhubarb,	1 fl. oz.
Tincture of Opium,	4 fl. dr.
Spirit of Camphor,	2 fl. dr.
Water of Ammonia,	1 fl. dr.
Oil of Peppermint,	80 min.

Mix. Dose, a teaspoonful in hot, sweetened water. Repeat as often as necessary till relieved.

Aromatic Blackberry Syrup.

(Dr. P. B. Goddard.)

Blackberry Juice,	16 fl. oz.
Sugar,	8 oz. (av.).
Nutmegs (grated),	120 gr.
Cinnamon (bruised),	120 gr.
Cloves,	60 gr.
Allspice,	60 gr.
Brandy,	8 fl. oz.

Mix.

Syrup of Pipsissewa.

Fluid Extract of Chimaphila,	4 fl. oz.
Syrup, a sufficient quantity to make	16 fl. oz.

Mix.

DRUGS CONTAINING ALKALOIDS.

Sun Cholera Mixture.

Tincture of Opium,
Tincture of Capsicum,
Tincture of Rhubarb,
Spirit of Camphor,
Spirit of Peppermint, of each, 1 fl. oz.

Mix. Dose, a teaspoonful in water after each evacuation of the bowels.

Compound Tincture of Opium.

(Squibb's Diarrhœa Mixture.)

Tincture of Opium,	1 fl. oz.
Tincture of Capsicum,	1 fl. oz.
Spirit of Camphor,	1 fl. oz.
Purified Chloroform,	3 fl. dr.
Alcohol, sufficient to make	5 fl. oz.

Mix. Dose, from 30 to 60 minims.

Diarrhœa Mixture.

(Velpeau's.)

Tincture of Opium,	1 fl. oz.
Tincture of Rhubarb,	1 fl. oz.
Camphorated Tincture of Opium,	1 fl. oz.
Spirit of Peppermint,	10 fl. dr.
Tincture of Capsicum,	6 fl. dr.

Mix.

Godfrey's Cordial.

Tincture of Opium,	8 fl. oz.
Potassium Carbonate,	150 gr.
Oil of Sassafras,	30 min.
Molasses (sugar-house),	32 fl. oz.
Alcohol,	4 fl. oz.
Water,	52 fl. oz.

Dissolve the Potassium Carbonate in the Water, add the Molasses, and heat over a gentle fire till they simmer; remove the scum which rises, and add the Tincture of Opium and Oil, having previously mixed them together.

Bateman's Pectoral Drops.

Opium,	120 gr.
Catechu,	120 gr.
Camphor,	120 gr.
Oil of Anise,	30 min.
Caramel,	1½ fl. oz.
Diluted Alcohol,	64 fl. oz

Digest for ten days.

Jackson's Pectoral Syrup.

Oil of Sassafras,	64 min.
Tincture of Tolu,	8 fl. oz.
Magnesium Carbonate,	2 oz. (troy).
Water,	8 pints.
Sugar,	14 lb. (av.).
Morphine Hydrochlorate,	64 gr.

Rub up the Tincture of Tolu and Oil of Sassafras with the Carbonate, gradually add ½ lb. of the Sugar and then the Water, filter, recovering 8 pints, in which dissolve the remainder of the Sugar. Dissolve the Morphine in 1 fl. oz. of Water,

add to the Syrup, and make the measure up to 16 pints.

Battley's Sedative.

Extract of Opium,	360 gr.
Boiling Water,	7 fl. oz.
Alcohol,	1½ fl. oz.
Cold Water, sufficient to make	10 fl. oz.

Dissolve the Extract in Boiling Water; when cold, add to the solution the Alcohol and enough Water to make 10 fl. oz.; and, lastly, filter through paper. Dose, 5 minims.

Camphorated Dover's Powder.

(Dr. Eli Ives's.)

Potassium Bitartrate,	1 oz. (troy).
Powdered Camphor,	120 gr.
Powdered Ipecac,	60 gr.
Powdered Opium,	60 gr.

Mix, and pass through a fine sieve.

Confectio Opii. *U. S.* 1870.

CONFECTION OF OPIUM.

Opium, in fine powder,	270 gr.
Aromatic Powder,	6 oz. (troy).
Clarified Honey,	14 oz. (troy).

Rub the Opium with the Aromatic Powder, then add the honey, and beat the whole together until thoroughly mixed.

Asiatic Tincture.

(For cholera.)

Opium,	240 gr.
Camphor,	240 gr.
Capsicum,	240 gr.
Oil of Cloves,	4 fl. dr.
Compound Spirit of Ether,	8 fl. oz.

Macerate from ten to twenty days, or prepare by percolation in a close percolator. Dose, 20 to 60 drops every second, third, or fourth hour in sweetened water.

Tinctura Opii Acetata. *U. S.* 1870.

ACETATED TINCTURE OF OPIUM.

Powdered Opium,	2 oz. (troy).
Distilled Vinegar,	12 fl. oz.
Alcohol,	8 fl. oz.

Macerate for a week, express, and filter.

Liquor Opii Compositus.

COMPOUND SOLUTION OF OPIUM.

(Squibb's.)

Deodorized Solution of Opium, containing 15 gr. of Morphine,	14 fl. dr.
Alcohol,	13 fl. dr.
Purified Chloroform,	1 fl. dr.
Acetic Ether,	2 fl. dr.

Mix. See Am. Jour. Pharmacy, 1870, p. 47. Dose, 15 to 30 min.

Ferrated Elixir of Calisaya.

Citrate of Iron and Ammonium,	512 gr.
Elixir of Calisaya,	32 fl. oz.

Dissolve.

Golden Tincture.

Ether,	2 fl. oz.
Tincture of Opium,	2 fl. oz.
Chloroform,	4 fl. dr.
Alcohol,	2 fl. oz.

Mix. Dose, 3 to 20 drops.

Syrup of Morphine.

(SIROP DE MORPHINE. Fr. Codex.)

Morphine Hydrochlorate,	1 gr.
Distilled Water,	20 min.
Syrup, sufficient to make	27 fl. dr.

Mix. A tablespoonful contains about ¼ gr. Morphine.

Schuyler's Powder.

Morphine Sulphate,	15 gr.
Camphor,	90 gr.
Powdered Ipecac,	90 gr.
Powdered Glycyrrhiza,	1½ oz. (troy).
Sugar,	1½ oz. (troy).

Mix.

Liquor Morphiæ Sulphatis. *U. S.* 1870.

SOLUTION OF SULPHATE OF MORPHIA.

Morphine Sulphate,	8 gr.
Distilled Water,	8 fl. oz.

Dissolve the Sulphate in the Distilled Water.

Gout Mixture.

(Laville's.)

Quinine Sulphate,	30 gr.
Cinchonine Sulphate,	22 gr.
Extract of Colocynth,	195 gr.
Diluted Alcohol,	3 fl. oz.
Red Wine, sufficient to make	16 fl. oz.

Mix.

Neuralgia Pills.

(Prof. Gross's.)

Quinine Sulphate,	60 gr.
Morphine Sulphate,	1½ gr.
Strychnine,	1 gr.
Arsenious Acid,	1½ gr.
Extract of Aconite,	15 gr.

Mix, and make into 30 pills.

Elixir of Calisaya.

Quinine Sulphate,	72 gr.
Cinchonine Sulphate,	24 gr.
Quinidine Sulphate,	20 gr.
Cinchonidine Sulphate,	12 gr.
Elixir of Orange,	128 fl. oz.

Caramel, a sufficient quantity to color.

Triturate the mixed Sulphates with 1 pint of the Elixir; pour the mixture into a glass flask, and heat in a water-bath until the solution is effected; while still hot, add the remainder of the Elixir and Caramel; when cold, filter.

Pills of Chinoidine.

Chinoidine,	60 gr.
Diluted Sulphuric Acid,	sufficient.

Soften the Chinoidine with the Acid in the mortar, and divide into 20 pills.

Elixir Cinchonæ. ELIXIR OF CINCHONA.

Compound Tincture of Cinchona,	1½ fl. oz.
Syrup,	2½ fl. oz.
Elixir of Orange,	12 fl. oz.

Filter, after the addition of 120 grains of Calcium Phosphate, if necessary.

Compound Tincture of Ignatia.

(GOUTTES AMÈRES. BITTER DROP.)

Ignatia,	8 oz. (troy).
Alcohol, 60 per cent.,	16 oz. (by weight).
Potassium Carbonate,	30 gr.
Charcoal,	6 gr.
Oil of Wormwood,	6 fl. dr.

Macerate fifteen days, and then recover 16 fl. oz. by percolation.

Hall's Solution.

Strychnine Acetate,	1 gr.
Acetic Acid,	20 min.
Alcohol,	2 fl. dr.
Water,	6 fl. dr.

Dose, 10 drops thrice daily, as a tonic in nervous exhaustion.

Vinum Tabaci. *U. S.* 1870.

WINE OF TOBACCO.

Tobacco,	240 gr.
White Wine,	8 fl. oz.

Macerate and filter.

Gout Pills.

(Becquerel's.)

Quinine Sulphate,	60 gr.
Extract of Digitalis,	7½ gr.
Powdered Colchicum-Seed,	20 gr.

Make into a mass and divide into 25 pills. Dose, 1 to 3 pills each day for several days.

Gout Pills.

(Lartigue's.)

Compound Extract of Colocynth,	96 gr.
Acetated Extract of Colchicum,	10 gr.
Extract of Digitalis,	5 gr.

Make into a mass and divide into 24 pills. Take 2 for a dose.

Rheumatic Pills.

(Dr. Isaac Remington's.)

Acetic Extract of Colchicum, Compound Extract of Colocynth, Extract of Rhubarb,	of each, 60 gr.
Veratrine,	5 gr.
Oil of Anise,	10 drops.

Make into 40 pills. Take 1 or 2 at bedtime.

Ethereal Tincture of Colchicum.

Colchicum,	8 oz. (troy).
Spirit of Nitrous Ether, sufficient to make	8 fl. oz.

Made by percolation. Dose, 20 to 30 drops.

Mixture for Gout.

(Scudamore's.)

Magnesium Sulphate,	240 gr.
Magnesia,	80 gr.
Vinegar of Colchicum,	4 fl. dr.
Syrup of Saffron,	4 fl. dr.
Peppermint Water,	5 fl. oz.

Mix. Dose, 1 to 3 tablespoonfuls every two hours till four to six evacuations are produced in twenty-four hours.

Linimentum Aconiti. *U. S.* 1870.

LINIMENT OF ACONITE.

Aconite, in fine powder,	8 oz. (troy).
Glycerin,	1 fl. oz.
Alcohol, a sufficient quantity.	

Moisten the powder with 4 fl. oz. of Alcohol, and let it macerate for twenty-four hours, then pack in a conical percolator, and gradually pour Alcohol upon it until 2 pints of tincture have been obtained. Distil off a pint and a half of Alcohol, and evaporate the remainder until it measures 7 fl. oz.; to this add the Glycerin, and mix them thoroughly.

Tincture of Aconite.

(Flemming's.)

Aconite, in fine powder,	8 oz. (troy).
Alcohol, sufficient.	

Macerate for four days with 8 fl. oz. of Alcohol, then pack into a percolator, and add more Alcohol until 12 fl. oz. of tincture are obtained.

Remedy for Tape-Worm.

(Schafhirt's.)

Pomegranate,	240 gr.
Pumpkin-Seed,	1 oz. (troy).
Ethereal Extract of Aspidium,	60 gr.
Powdered Ergot,	30 gr.
Powdered Acacia,	120 gr.
Croton Oil,	2 min.

Mix.

Dinner Pills.

(Fothergill's.)

Powdered Ipecac,	20 gr.
Strychnine,	1 gr.
Oil of Black Pepper,	40 min.
Pill of Aloes and Myrrh,	50 gr.

Mix, and make into 20 pills.

Elixir of Guarana.

Fluid Extract of Guarana,	2½ fl. oz.
Elixir of Orange, a sufficient quantity to make	16 fl. oz.

Mix.

Number One.

(Thomsonian name.)

Lobelia inflata.

Brown Lobelia.

The Thomsonian name for the *seed.*

Green Lobelia.

The Thomsonian name for the *herb*.

Third Preparation.

(Thomsonian name.)

Lobelia-Seed,	
Capsicum,	of each, 1 oz. (av.).
Cypripedium Powder,	10 gr.

Add 12 fl. oz. of Number Six (page 1031), macerate, and keep on the dregs.

Syrup of Lobelia.

(Thomsonian name.)

Lobelia-Seed,	1 oz. (av.).
Sugar,	16 oz. (av.).
Tincture of Lobelia,	4 fl. oz.
Vinegar,	1 fl. oz.
Water,	16 fl. oz.

Boil the Seed with the Vinegar and Water for half an hour; add the Sugar; and lastly, when cold, add the Tincture of Lobelia.

Tobacco Ointment.

Tobacco, in fine powder,	120 gr.
Lard,	4 oz. (troy).
Water, sufficient.	

Percolate the Tobacco with Water until 2 fl. oz. have been obtained, evaporate to an extract, and mix with the Lard.

Compound Elixir of Turkey Corn.

Fluid Extract of Corydalis,	4 fl. dr.
Fluid Extract of Stillingia,	4 fl. dr.
Fluid Extract of Prickly Ash,	2 fl. oz.
Fluid Extract of Iris,	6 fl. oz.
Potassium Iodide,	180 gr.
Alcohol,	1 fl. oz.
Elixir of Orange,	5 fl. oz.

Mix the Elixir and Alcohol, and add the Fluid Extracts; dissolve the Iodide in the mixture, and allow it to stand twenty-four hours, then filter.

ANIMAL PRODUCTS.

Elixir of Pepsin.

Saccharated Pepsin,	192 gr.
Citric Acid,	10 gr.
Spirit of Orange,	1 fl. dr.
Water,	2 fl. oz.
White Wine,	4 fl. oz.
Syrup, a sufficient quantity to make	8 fl. oz.

Dissolve the Pepsin in the Water and Wine by the aid of the Acid, add the Syrup and Spirit of Orange, previously mixed, and then filter.

Beef, Wine, and Iron.

Liebig's Extract of Beef,	2 oz. (av.).
Water,	4 fl. oz.
Wine of Iron,	64 fl. oz.
Sherry Wine,	64 fl. oz.

Dissolve the Extract of Beef in hot Water, add to the Wines, and filter.

Wine of Pepsin.

Saccharated Pepsin,	4 oz. (av.).
White Wine,	56 fl. oz.
Syrup,	8 fl. oz.

Dissolve the Pepsin in the Wine and Syrup, and filter.

Elixir of Pepsin and Bismuth.

Citrate of Bismuth and Ammonium,	64 gr.
Elixir of Pepsin,	8 fl. oz.

Dissolve the Bismuth salt in a little water, with the aid of a few drops of Water of Ammonia, add the Elixir, and then filter.

Emulsion of Cod Liver Oil.

(50 per cent.)

Cod Liver Oil,	8 fl. oz.
Powdered Acacia,	2 oz. (av.).
Water,	4 fl. oz.

Place the Powdered Acacia in a dry mortar, add the Cod Liver Oil, and rub until smooth; then add the Water all at once, and rub until a perfect emulsion is formed; then add sufficient Water to make 16 fl. oz.

Emulsion of Cod Liver Oil with Phosphate of Calcium and Sodium.

Calcium Phosphate,	256 gr.
Sodium Phosphate,	64 gr.
Acacia,	2 oz. (av.).
Hydrochloric Acid,	128 min.
Cod Liver Oil,	8 fl. oz.
Water,	4 fl. oz.

Place the Powdered Acacia in a dry mortar, add the Cod Liver Oil, and rub until smooth. Dissolve the Phosphates in the Water by the aid of the Acid, and add all at once to the above mixture, rubbing until a perfect emulsion is formed; then add sufficient Water to make 16 fl. oz.

Emulsion of Cod Liver Oil with Lactophosphate of Calcium.

Calcium Lactate,	256 gr.
Acacia,	2 oz. (av.).
Diluted Phosphoric Acid,	2 fl. oz.
Cod Liver Oil,	8 fl. oz.
Water,	2 fl. oz.

Place the Powdered Acacia in a dry mortar, add the Cod Liver Oil, and rub until smooth. Dissolve the Calcium Lactate in Acid and Water, and add all at once to the above mixture, rubbing until a perfect emulsion is formed; then add sufficient Water to make 16 fl. oz.

Pancreatic Emulsion of Cod Liver Oil.

Cod Liver Oil,	3 fl. oz.
Powdered Pancreatin,	60 gr.
Syrup,	1 fl. oz.

Digest at a moderate heat. The emul-

sion is miscible with water, and may be given in chocolate, milk, coffee, or both.

Emulsion of Cod Liver Oil with Wild Cherry Bark.

Acacia,	2 oz. (av.).
Oil of Bitter Almond,	8 min.
Fluid Extract of Wild Cherry,	1 fl. oz.
Cod Liver Oil,	8 fl. oz.
Water,	8 fl. oz.

Place the Powdered Acacia in a dry mortar, add the Cod Liver Oil, and rub until smooth. Mix the Fluid Extract with the Water, and add all at once to the above mixture; then add the Oil of Bitter Almond, and, lastly, sufficient Water to make 16 fl. oz.

Emulsion of Cod Liver Oil with Hypophosphites.

Calcium Hypophosphite,	128 gr.
Sodium Hypophosphite,	96 gr.
Potassium Hypophosphite,	64 gr.
Acacia,	2 oz. (av.).
Cod Liver Oil,	8 fl. oz.
Water,	4 fl. oz.

Place the Powdered Acacia in a dry mortar, add the Cod Liver Oil, and rub until smooth. Dissolve the Hypophosphites in the Water, and add all at once to the above mixture, rubbing until a perfect emulsion is formed; then add sufficient Water to make 16 fl. oz.

Emulsion of Cod Liver Oil with Hypophosphite of Calcium and Sodium.

Calcium Hypophosphite,	128 gr.
Sodium Hypophosphite,	96 gr.
Powdered Acacia,	2 oz. (av.).
Cod Liver Oil,	8 fl. oz.
Water,	4 fl. oz.

Place the Powdered Acacia in a dry mortar, add the Cod Liver Oil, and rub until smooth. Dissolve the Hypophosphites in the Water, and add all at once to the above mixture, rubbing until a perfect emulsion is formed; then add sufficient Water to make 16 fl. oz.

Emulsion of Cod Liver Oil with Hypophosphite of Calcium.

Cod Liver Oil,	8 fl. oz.
Powdered Acacia,	2 oz. (av.).
Calcium Hypophosphite,	128 gr.
Water,	4 fl. oz.

Place the Powdered Acacia in a dry mortar, add the Cod Liver Oil, and rub until smooth. Dissolve the Calcium Hypophosphite in the Water, and add all at once to the above, rubbing until a perfect emulsion is formed; then add sufficient Water to make 16 fl. oz.

Ethereal Tincture of Cantharides.

Cantharides,	1 oz. (troy).
Spirit of Nitrous Ether,	14 fl. oz.

Macerate for eight days, and filter.

Unguentum Cantharidis. *U. S.* 1870.

OINTMENT OF CANTHARIDES.

Cantharides,	
Yellow Wax,	of each, 1 oz. (av.).
Olive Oil,	6 fl. oz.

Infuse the Cantharides in the Oil in a covered vessel for twelve hours; then place the vessel in boiling water for fifteen minutes, strain through muslin with strong pressure, add the product to the wax, previously melted, and stir constantly while the mixture cools.

Hair Tonic.

(Prof. Gross.)

Tincture of Cantharides,	90 min.
Tincture of Capsicum,	20 min.
Glycerin,	30 min.
Perfumed Spirit, sufficient to make	6 fl. oz.

Mix.

Antispasmodic Mixture.

(Sydenham's.)

Tincture of Valerian,	5 fl. dr.
Compound Spirit of Ether,	1 fl. dr.
Tincture of Castor,	10 fl. dr.
Fennel Water,	12½ fl. oz.

Mix. Dose, a tablespoonful every three or four hours.

Tinctura Castorei. *U. S.* 1870.

TINCTURE OF CASTOR.

Castor (bruised),	1 oz. (troy).
Alcohol,	16 fl. oz.

Macerate for seven days, express, and filter through paper.

SODA-WATER SYRUPS.

Vanilla Syrup.

Fluid Extract of Vanilla,	2 fl. oz.
Syrup, a sufficient quantity to make	32 fl. oz.

Mix.

Ginger Syrup.

Tincture of Ginger,	4 fl. oz.
Syrup, a sufficient quantity to make	128 fl. oz.

Mix.

Lemon Syrup.

Solution of Citric Acid (1 in 10),	8 fl. oz.
Spirit of Lemon,	1½ fl. oz.
Syrup,	8 pints.
Tincture of Curcuma, a sufficient quantity to color.	

Mix.

Syrup of Sarsaparilla.

Fluid Extract of Sarsaparilla,	2 fl. oz.
Oil of Sassafras,	
Oil of Anise,	of each, 12 min.
Oil of Gaultheria,	9 min.
Syrup, a sufficient quantity to make	8 pints.

Mix.

Orange Syrup.

Oil of Orange (Fresh),	10 min.
Citric Acid,	120 gr.
Syrup,	64 fl. oz.

Mix.

Strawberry Syrup.

Strawberry Juice,	32 fl. oz.
Sugar,	128 oz. (av.).
Water,	32 fl. oz.

Mix the Juice and Water, and dissolve the Sugar by percolating with the mixture.

Raspberry Syrup.

Raspberry Juice,	32 fl. oz.
Sugar,	128 oz. (av.).
Water,	32 fl. oz.

Mix the Juice and Water, and dissolve the Sugar by percolating with the mixture.

Syrup of Pineapple.

Pineapple Juice,	32 fl. oz.
Sugar,	128 oz. (av.).
Water,	32 fl. oz.

Mix the Juice and Water, and dissolve the Sugar by percolating with the mixture.

Nectar Syrup.

Vanilla Syrup,	40 fl. oz.
Pineapple Syrup,	8 fl. oz.
Strawberry Syrup,	16 fl. oz.

Mix.

Sherbet Syrup.

Vanilla Syrup,	48 fl. oz.
Pineapple Syrup,	16 fl. oz.
Lemon Syrup,	16 fl. oz.

Mix.

Chocolate Syrup.

Best Chocolate,	8 oz. (av.).
Sugar,	64 oz. (av.).
Water,	32 fl. oz.

Mix the Chocolate in the Water, and stir thoroughly over a slow fire; strain, and add the Sugar.

Coffee Syrup.

Coffee (roasted),	8 oz. (av.).
Boiling Water,	8 pints.
Sugar,	112 oz. (av.).

Make an infusion, filter, add the sugar, and strain.

COLORS FOR SHOW-BOTTLES.

Dark Blue.

Copper Nitrate,	4 oz. (av.).
Water,	16 pints.

Water of Ammonia, a sufficient quantity.

Dissolve the Copper salt, add Ammonia as long as it deepens the color; filter.

Dark Green.

Copper Sulphate,	8 oz. (av.).
Potassium Bichromate,	60 gr.
Water,	16 pints.

Mix, and filter.

Red.

Fuchsine,	20 gr.
Acetic Acid,	2 fl. oz.
Water,	8 pints.

Mix.

Yellow.

Potassium Bichromate,	4 oz. (av.).
Nitric Acid,	4 fl. oz.
Water,	16 pints.

Mix, and filter.

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